APRIL 1957

Power Engineering

Keep Your Evaporative Condensers at Top Efficiency 75
Good Turbine Foundations Prevent Maintenance Headaches 78
How To Service Ball and Roller Bearings – Part I, Effects of Design 80
Northern States Power Co. Plans 60,000-kw Nuclear Plant 86
Need An Educated Power Plant? This One Thinks for Itself 87
How To Check Boiler Feedwater System in Plant Start-Up 88
Build Your New Boiler Plant Right for Good Operation 90
Get Rid of Oil Spills This Easy Way 94
Makeshift Rig Performs Low-Cost Generator Repair 95
Factors Influencing Starting Duty of Large Induction Motors 96
TV Monitor Saves $10,000 a Year 99
Soot Blowers Give Cromby Broad-Range Steam Temperature Control 100
Turbine Business: Barometer of Future Economic Health 101
You Can Calibrate Meters Easier – It's Smarter 102
How To Measure Small Amounts of Silica in Feedwater 104
This Short-Cut Pays Off in Turbine Operation 108
Lubricant Additives With a Purpose – To Improve Lubrication 112

REGULAR DEPARTMENTS

Engineers' Preview 3
What They Tell Us 6
Helpful Bulletins 25
Construction News 46
Equipment News 48
News Reel 84
POWER ENGINEERING Handbook 106
New Engineering Books 124
Catalog Library 139
Reader Service Post Cards 139
Advertisers' Index 154
Circulation of This Issue 40,810

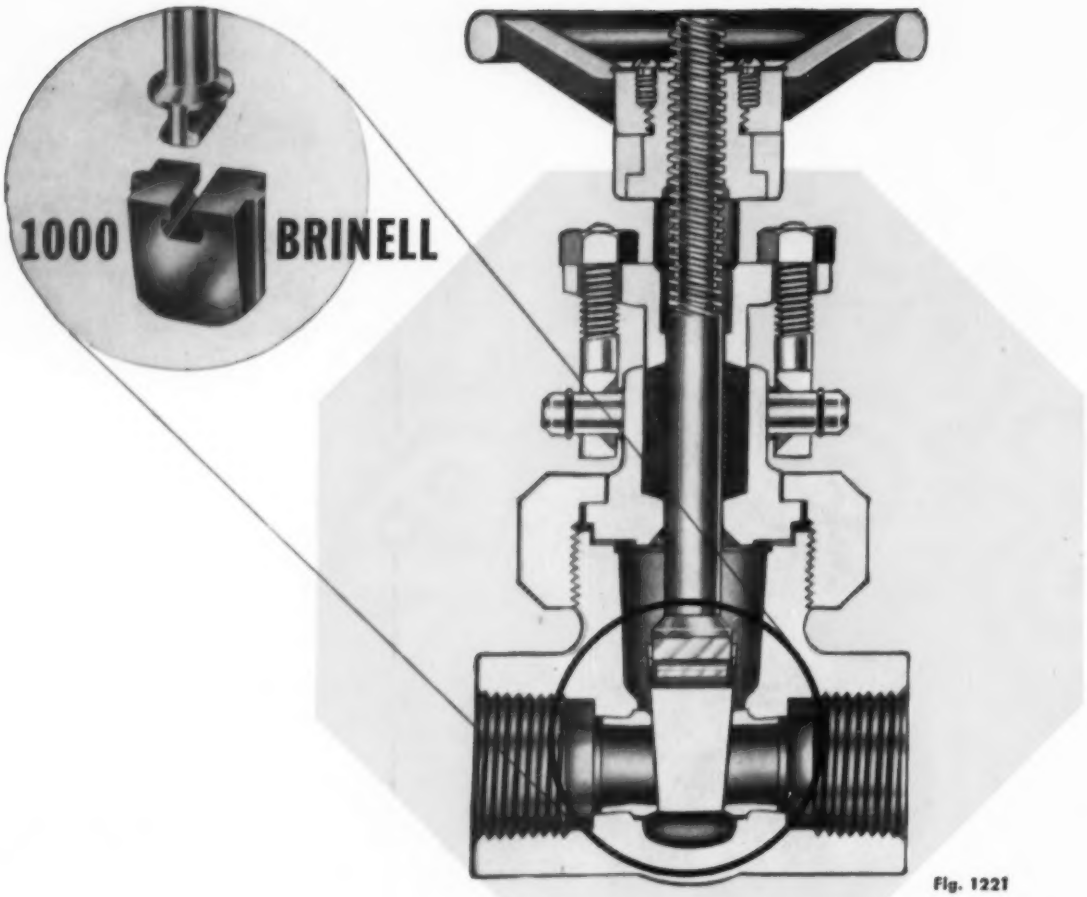

Fig. 1221

Stop Galling with the hardest valve wedges you can buy

OIC VALVES

FORGED & CAST STEEL,
BRONZE & IRON,
LUBRICATED PLUG VALVES

Highly resistant to erosion and corrosion

Here's a wedge as hard as flint . . . so hard that it's undamaged by pipe cuttings, scale or grit. It's the only trim we know of which will successfully withstand the simultaneous attack of the three valve-destroying agents—corrosion, erosion, galling. This wedge is *13% chrome stainless steel hardened up to 1000 Brinell.*

Specify the OIC 1221 gate or 1621 globe where you need the extra rugged nature of forged steel. They are recommended for steam service up to 800°F...oil service up to 1000°F. Or, use these same valves for hydraulic service up to 2000 lbs.

Write for Form 195 for specifications on the OIC forged steel line.

THE OHIO INJECTOR COMPANY
WADSWORTH, OHIO

For more data circle 501 on Post Card

RESEARCH at Pittsburgh Piping

Stress analysis of model of power piping system at Pittsburgh Piping accurately predicts physical reactions of full size system in service.

another
P. P. & E. service
which contributes to
Improved
HIGH-TEMPERATURE
HIGH-PRESSURE
PIPING

(Below) Metallographic examination of piping materials and weld samples reveals changes which occur in a metal's crystalline structure due to operating conditions and fabricating procedures.

(Above) Fabricated sections comprising 20" pipe and elbows shop fabricated at Pittsburgh Piping.

Our technical staff constantly explores the mechanical and metallurgical aspects of power and process piping. For example, stress analysis by model testing is used to predict accurately the physical reactions of high-temperature, high-pressure piping in service. Extensive investigations are conducted on the metallurgical effects of operating conditions and fabricating procedures on piping materials. This knowledge pays off in the sound piping systems we fabricate and erect for central stations and nuclear power installations.

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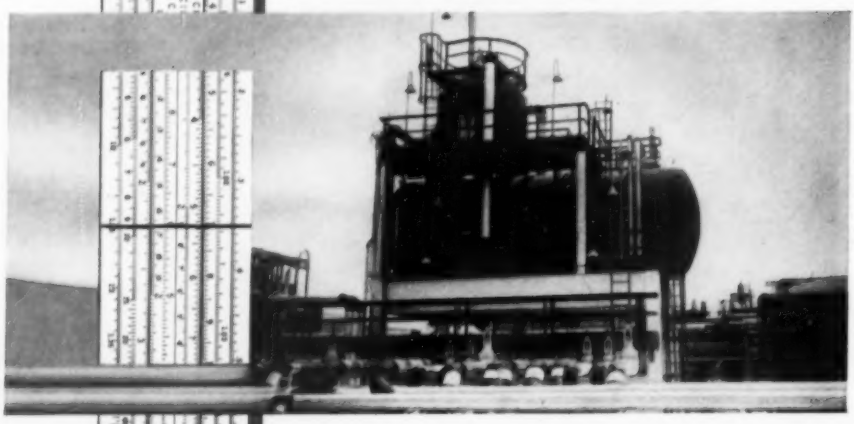
DEPENDABILITY



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Tray Heater Bulletin WC-106

Industrial Department: I-112

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A Division of Graver Tank & Mfg. Co., Inc.
216 West 14th Street, New York 11, N. Y.

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NBP EPA

PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

ENGINEERS' PREVIEW

NATIONAL LADDER MONTH is upon us — April that is — just in case you hadn't noticed it. It is all hooked up with clean-up, fix-up and paint-up week, which also comes this month. The intention is to emphasize the importance of ladders, both in the home and in industry — and, of course, to stimulate the sale of ladders. American Ladder Institute is putting on quite a campaign, with prizes for people who sell ladders, and distribution of various publications on ladder safety, in coöperation with the National Safety Council.

Doubtless readers remember our article entitled How to Outlast Your Ladder, published in the POWER ENGINEERING Handbook, December 1955. Anyway, if you need the latest dope on ladders and ladder safety, write to L. Carter Watling, Chairman Publicity Committee, National Ladder Program, American Ladder Institute, 122 N 7 St, St. Louis 1, Mo.

SOME YEARS AGO, it was quite the thing for newspaper columnists, radio announcers, drama critics, and others, to award "orchids" to various individuals for an outstanding performance or book, or something of that sort. At that time the *Engineers' Preview* editor had the same habit — somewhat corny, we admit — of awarding a "carnation" every month to some manufacturer or other organization for publication of an outstanding catalog or bulletin of some kind. It might be outstanding in appearance or outstanding in technical content, and frequently was both.

If we were still awarding that carnation, we certainly would award it now to Sargent & Lundy, the consulting engineering firm, for a most admirable brochure they have published on the occasion of the firm's 65th anniversary. This is a 40-page booklet describing the full range of services offered to the steam-electric power industry by that firm.

One of the outstanding features is a display of 31 full-color photographs of various power plants designed by the firm during the past 40 years. A particularly interesting photograph shows the four original members of the firm beginning in 1891, and next to it is a color photograph of the present members.

The color reproductions in this book are of the highest order, showing exterior and interior views of many of the important power plants of the country that engineers have seen or read about. If you want a copy of it, write the *Engineers' Preview* Editor.

AN INTERESTING experiment on hard hats was carried out recently at Standard Oil Company's refinery at Whiting, Indiana.

One of the excuses given for not wearing hard hats was that they were too hot to wear in summer. To test the validity of this excuse, heat lamps were suspended above a hard hat and also above two types of ordinary hats commonly worn by the employees. Thermocouples registered temperatures inside the hats.

Here are typical readings obtained from the tests:

	Outside	Inside
Peaked Cap	112F	110F
Felt Hat	112F	108F
Hard Hat	110F	88F

In every demonstration, the hard hat proved to be much cooler than the other hats tested.

FIRST STAGE of delivery on eight giant hydraulic turbines to the St. Lawrence Power Project has been completed by the Eddystone Division of Baldwin-Lima-Hamilton Corp. All the draft tube liners — lowest sections of the turbines — have been delivered to the site of the Long Sault Power station. Installation of these liners is 50 per cent completed. Shipment of the next big pieces will begin in February. These next items will be the stay-rings and pit liners.

A part of the power-generating

system being installed on the St. Lawrence Seaway in the Long Sault dam at Barnhart Island, New York, the eight generators will produce 120,000 hp when they are completed in 1959.

CAPTIVE KILOWATTS, a new 16-mm color-sound movie describing the reversible pump-turbine and its use to level system load curves is now available from Allis-Chalmers for showing before engineering groups. Requests for prints of Captive Kilowatts should be made to the nearest Allis-Chalmers Industries Group sales office or to the company's Advertising & Industrial Press Department, Milwaukee 1, Wis.

HAGAN Corporation changed its name to Hagan Chemicals & Controls, Inc, effective January 1, 1957. At the same time, its subsidiaries, Calgon, Inc, Hall Laboratories, Inc, and the Buromin Co will be merged into the parent company. Calgon and Hall will continue as divisions. In announcing the change, W. W. Hapgood, Hagan president, said that the new name will better describe the company's activities in the fields of chemical engineering and automatic control equipment.

H. D. EMMERT, JR. has been appointed chief engineer of Allis-Chalmers steam turbine department succeeding H. S. Bimpson, retired, announced by R. N. Miers, manager of the department.

Emmert joined Allis-Chalmers in 1937 after receiving his mechanical engineering degree from Georgia Tech. Just prior to World War II he was assigned to supercharger work. He served with the U. S. Army in the Pacific from 1942 to 1945 and was discharged as a lieutenant-colonel of artillery.

Upon his return to Allis-Chalmers in October, 1945, he was named engineer-in-charge of research in the steam turbine department. In 1947 he was transferred in a like capacity to the turbo-power development department where he worked on the design of special gas turbine and steam turbine units.

In 1951 Emmert was placed in charge of the turbo-prop engine section, a post held until early in 1954 when he became engineer-in-charge of development for the steam turbine department. Since 1955 he had been assistant chief engineer of the department.

Emmert is a member of ASME, a registered professional engineer in Wisconsin.

Bimpson, a 1917 mechanical engineering graduate of the University of Virginia, joined Allis-Chalmers in 1920. He served in various capacities and became chief engineer of the steam turbine department in January, 1952.

We Are Looking For Editors

POWER ENGINEERING is expanding and will have openings for graduate engineers in the mechanical or electrical field with a good solid background of operating, design, and construction experience. If you like to travel, meet people, learn of new developments, investigate new ideas, and if you have imagination, ingenuity and tact, together with a reasonable command of English, you will find this interesting work. There are several openings on the editorial staff, but the immediate one has the following specifications:

A graduate engineer from 45 to 50 years of age, who has gone through a cadet or student engineer's course with one of the public utilities, spent a number of years in the operating department, two or three years in the power sales department, and a number of years as power engineer with industrial companies, and who holds a professional engineer's license.

Another opening could be filled by a graduate engineer about 30 years old, with good grounding in engineering fundamentals, and particularly in heat power engineering. Subsequent to graduation, he should have had several years of work in a utility or industrial power plant, or in an industry having diversified steam and electrical problems.

If you meet all or many of the above specifications and are interested in the above jobs, send complete details of your education and experience to Editor of POWER ENGINEERING, 110 So. Dearborn St., Chicago, Ill.

WISCONSIN Electric Power Co has placed a contract with Foster Wheeler Corp, for an additional steam generating unit for Oak Creek Station. This steam generator will have a capacity of 1,780,000 lb of steam per hour and will operate at 2425 psi, 1050F at the superheater outlet. The steam will be reheated to 1000F after passing through the first section of the 250,000-kw Allis-Chalmers turbine, which the new unit will serve.

The steam generator is scheduled for completion in late 1959 and will include combination radiant and convection superheaters, radiant reheaters, pulverized coal firing equipment, and ball mill pulverizers.

UNION PACIFIC Railroad has ordered a second group of fifteen 8500-hp gas-turbine-electric locomotives from General Electric Co. First group of 15 was ordered in November 1955, delivery of which is scheduled to start in July of this year.

Fleet of 25 smaller gas-turbine-electric units rated at 4500 hp has been in regular freight service on Union Pacific for several years. Latest announced figures show that this relatively small number of units is hauling 10 per cent of U. P.'s total freight tonnage.

PLOT OF LAND near Trenton, N. J., is being acquired by Public Service Electric and Gas Co as the site for a new steam-electric generating plant.

One 300,000-kw turbine generator will be installed initially, together with a boiler and auxiliary equipment for this unit. Station fuel handling and service facilities, and transformers and transmission lines required to integrate the new unit into the existing high-voltage transmission system will also be provided.

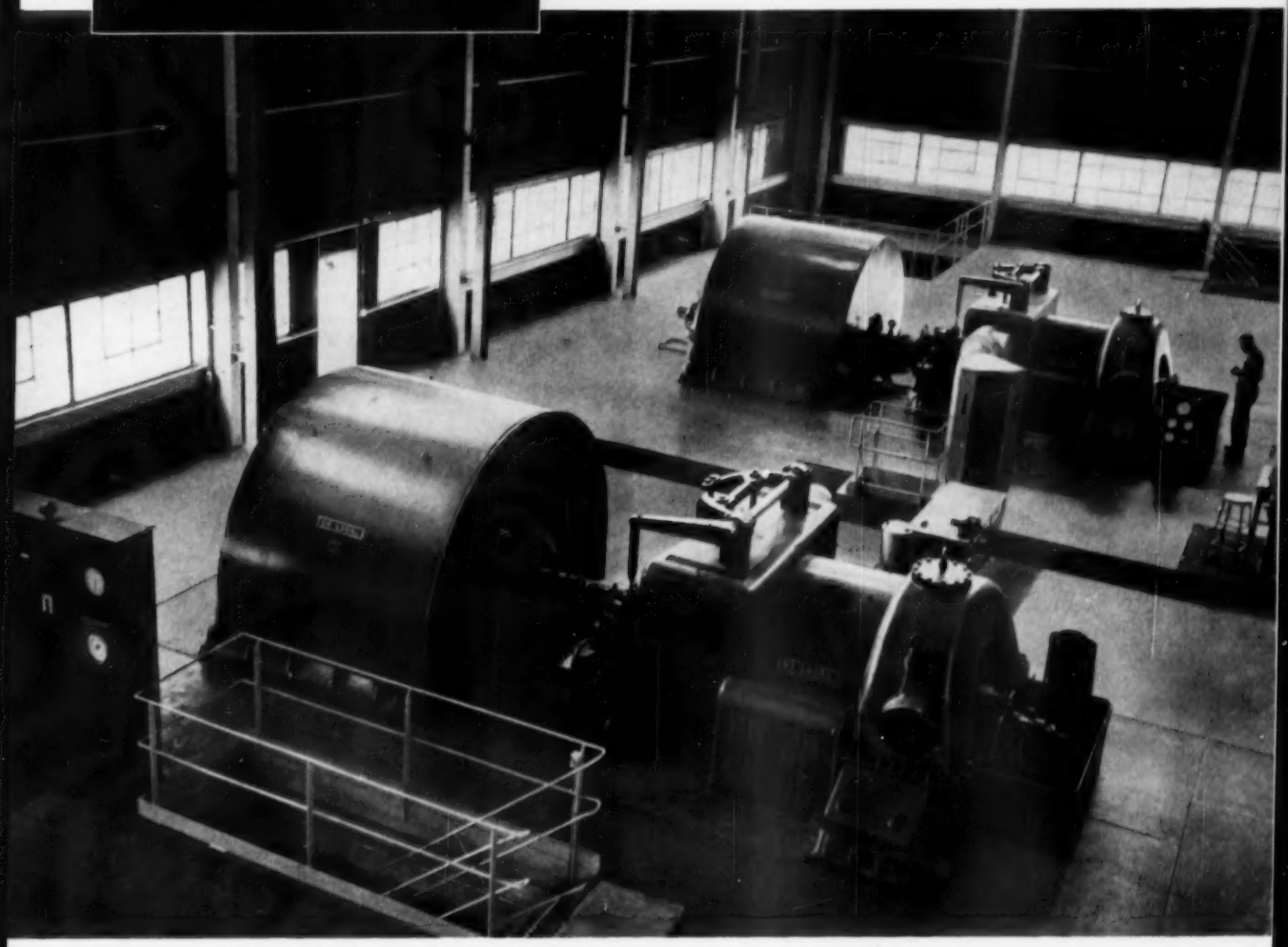
The completed project will cost $72,500,000.

Public Service is now building two new generating stations, one at Linden, and the other at Ridgefield, in Bergen County. These two plants will have an aggregate capacity of over 1,000,000 kw.

DE LAVAL

BLAST FURNACE BLOWERS

deliver 110,000 cfm each for McLouth Steel



These two De Laval turbine-driven centrifugal blowers do a round-the-clock job in the McLouth Steel plant, Trenton, Michigan. Each has a rated capacity of 110,000 cfm of air; discharge pressure is 30 psig. Each is driven by a 12,400 hp, 2950 rpm De Laval steam turbine operating under steam conditions of 600 psig, 825 F with 2″ hg.

De Laval compressors are designed individually for each application to assure maximum efficiency and range of operation. Construction is rugged throughout. Casings and perfectly balanced rotors are built to take punishment. All parts are precision-made to limit gages. Materials are selected which will best meet the particular conditions of corrosion, pressure and temperature.

De Laval centrifugal blowers are built in single and multi-stage types to supply air in volumes up to 150,000 cfm for all classes of service in steel, gas and coke plants. The wealth of application experience acquired by De Laval over the years assures a correct and economical solution to your blower problem.

Send for Bulletin 0504

DE LAVAL *Centrifugal Blowers*

DE LAVAL STEAM TURBINE COMPANY

816 *Nottingham Way, Trenton 2, New Jersey*

DL 360

WHAT THEY TELL US

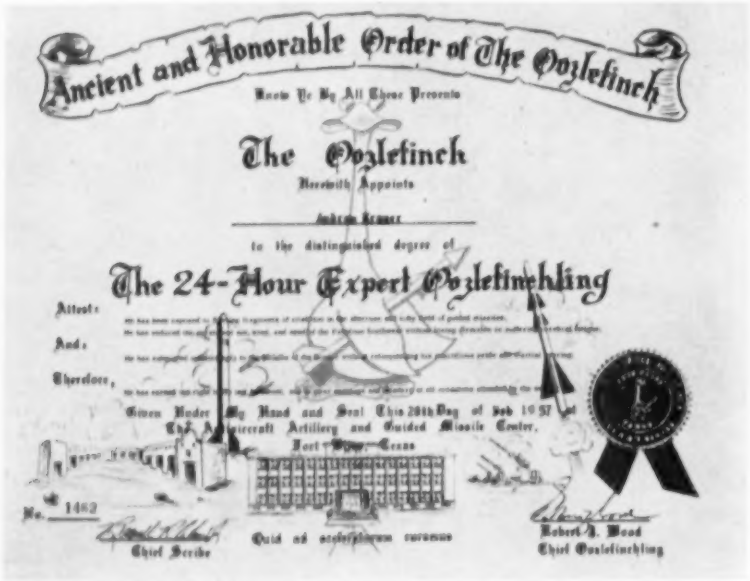
▶ **WHILE ON A TOUR** with the officers of the 78th AAA Missile Battalion, U. S. Army, to the Red Canyon Proving Ground in New Mexico to witness the firing of a number of Nike missiles, the Editor of POWER ENGINEERING was made a member of the Ancient and Honorable Order of the Oozlefinch. The presentation of the diploma certifying his membership in this exclusive organization was made at Ft. Bliss (El Paso, Tex.) on February 26 by Major General Robert J. Wood, Commander of Ft. Bliss.

The Oozlefinch has a long interesting history — too long to recount here. However, on 6 July 1956 (*that's Army style for writing dates*) the Oozlefinch, a legendary featherless bird of the Coast Artillery Corps, awakened from his sleep of several years, tucked a Nike in the crook of his nude left leg, and traveling by ways known only to himself, arrived at the Antiaircraft Artillery and Guided Missile Center — there to become the guardian of all missilemen.

The outstanding characteristic of this ageless bird is his eyes. These large, all-seeing eyes are unshaded by eyelids or eyebrows. Thus the great bird always flies backwards to keep the dust out of his eyes, and as a consequence, the Nike is always positioned at the correct attitude.

Having been exposed to the fleeting fragments of erudition in the abstruse and lofty field of guided missiles, our Editor is now entitled to this fabulous bird's protection.

The Oozlefinch is at once the confidant of generals, the protector of Very Important Persons, and above all, the guardian, patron and monstrous mentor of modern artillerymen.



▶ **V.V.T.**, General Electric's News Bureau, recently wrote Editor Kramer:

> You've undoubtedly seen the recent rash of news stories on the Cryotron computer that Arthur D. Little Co has announced it would build.
>
> I couldn't help thinking when I saw the story on Page 1 of the N. Y. Times and in featured spots in several other papers, that your piece in POWER ENGINEERING, way back last spring or summer beat them all.
>
> It was a swell job of reporting. You explained clearly and simply how Buck's little widget worked and what significance it had in the computer development field.

The article, entitled Something New Under the Sun — the Cryotron, appeared in POWER ENGINEERING's August 1956 issue, pages 86–88.

▶ **IN THE DECEMBER** 1956 issue of POWER ENGINEERING, page 74, we indicated that reprints of the picture story, Gas Engine Overhaul, are available to those who wish to use them for educational or training purposes. This sounds good to Roy C. Jones, Jr., Supervisor of Maintenance and Operation, Bureau of Sewage and Refuse Disposal, Department of Public Utilities, in a city in Oregon. Mr. Jones comments further:

> The article by Mr. Hagenmiller was very well done, and is right in line with the work I have been doing here in the training of our local operators.
>
> I have been asked to give instructions in operation and maintenance at the annual short school for sewage works operators next spring, and I believe I can use this article as one example in planned and controlled maintenance.
>
> It is articles such as this, as well as some of the technical items, that make POWER ENGINEERING a must for my library. Your publication has been of help to me on many occasions.

▶ **ALL WE HAVE** to do is publish some costs of power plant fuel, equipment, operation, maintenance, and POWER ENGINEERING'S readers bombard us with questions. Usually these can be answered only by the author.

So when Reader John A. Holbrook, of a local hospital, sent the following, we passed it right along to Author Gilkison:

> The article, Estimating the New Steam Plant, by Robert R. Gilkison, POWER ENGINEERING, August 1956 issue, has been very timely in reference to some studies we have been making in our hospital. In order to use Mr. Gilkison's data more completely, we would appreciate the following information:
>
> 1. Where is the plant located, or what is the approximate wage scale of the area?
>
> 2. Does the actual steam cost of 57 cents per 1000 lb with 2½-cent gas include depreciation, and if so, what rate of depreciation?
>
> 3. Does the $5.54 cost per lb of steam capacity include the building?
>
> In my opinion the article is very worthwhile, and covers a good deal of useable information.

Here's a part of what Gilkison told Holbrook:

> The plant is located in East Central Illinois, approximately 125 miles south of Chicago. The wage scale in that locality is $3.00 per hour for an operator of steam plant, where no electric power is generated. The operator is not required to be a licensed engineer, as in Cook County. The plant is not unionized and the company has provided benefits and

continued on page 32

One of a series.

An Inside Peek at Steam Trap Capacity Ratings

or . . . how to be sure steam heated equipment is going to work the way it's engineered

WHEN YOU GET all through engineering a steam heated process equipment installation, its performance will depend on whether your steam traps will do what the catalog said.

Now, in theory, if you know the size of a steam trap orifice, you can figure how much water can be pushed through it in a given time by a given steam pressure. But, in practice, this doesn't work out. The picture is scrambled by things like the choking effect of flash steam and restriction of flow through the trap and piping.

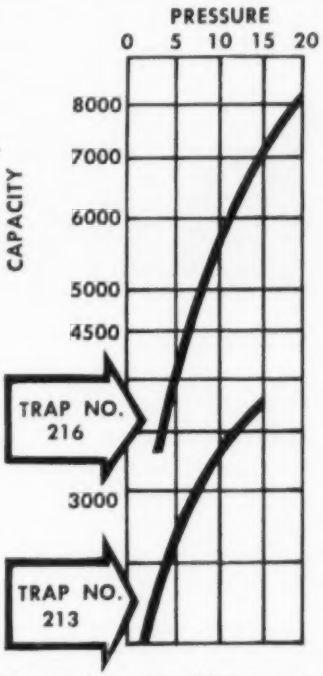


Fig. 1—Showing difference in volume of condensate discharged by a No. 216 trap with 2" pipe connections and a No. 213 trap with ¾" pipe connections—each trap having ½" discharge orifice.

For example, Fig. 1 shows that a ½" orifice in a 125 psi No. 216 Armstrong steam trap with 2" pipe connections will discharge 7200 lb/hr condensate at 15 psi inlet pressure. Yet, a ½" orifice in a 15 psi No. 213 trap with ¾" pipe connections, discharges but 3900 lb/hr at 15 psi inlet pressure. The difference: pipe friction.

Thus, we see a need for investigating the basis for steam trap capacity ratings. Unfortunately, they are not all arrived at in the same way. If they are based on cold water tests, producing no flash steam, they are much too high. Orifice tests are also too high because they ignore pipe friction. Calculations involving flow-through-orifice formulae have never been known to be conservative insofar as traps are concerned.

Armstrong Ratings

Armstrong trap capacity ratings are based on actual operating conditions, determined by hundreds of tests. In these tests condensate at the steam temperature corresponding to test pressure was used. Restriction of flow caused by the choking effect of flash steam, as well as the back pressure created by flash steam and condensate, automatically were taken into account. Actual installation hookups were used, so that pipe friction in both inlet and discharge lines also was reflected in the results.

All this effort assures you the nice, comfortable feeling that comes from knowing a trap will deliver on the job the full capacity claimed in the catalog.

* * *

There is one more ingredient that needs to be tossed into the trap-sizing pot. This morsel is the safety factor—the required excess of trap capacity over calculated condensate load. It will be the subject of the next advertisement in this series. But, in the meantime, if you'd like to get the lowdown, ask for a copy of the 44-page Armstrong Steam Trap Book. It is a complete guide to good trapping practice. It covers not only safety factors, but calculation of condensate loads and trap selection, installation, troubleshooting and maintenance. Just call your local Armstrong Factory Representative, or write: **Armstrong Machine Works, 8104 Maple St., Three Rivers, Michigan.**

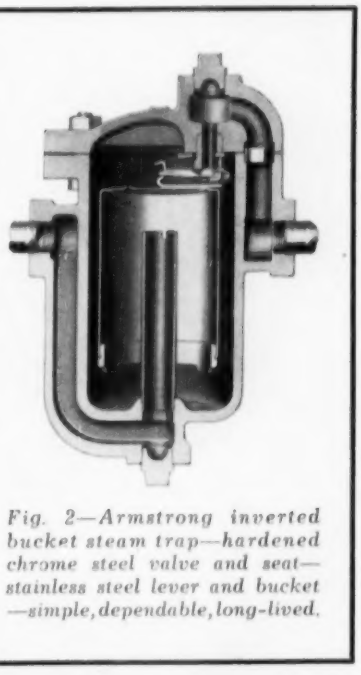


Fig. 2—Armstrong inverted bucket steam trap—hardened chrome steel valve and seat—stainless steel lever and bucket—simple, dependable, long-lived.

ARMSTRONG STEAM TRAPS

For more data circle 505 on Post Card

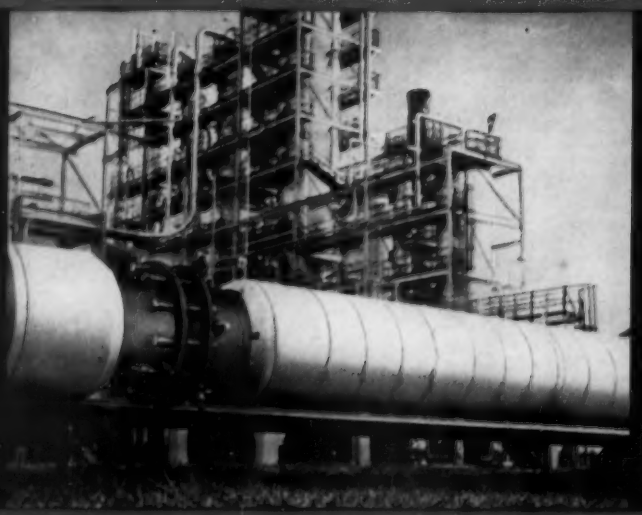
why engineers

IN THE AIR...

These Gun-Pakt Joints in overhead line are some of 22 Yarway Gun-Pakt Joints installed at a large Southern hospital.

ON THE GROUND...

One of 37 Yarway Gun-Pakt Expansion Joints installed at giant oil refinery. Gun-Pakt Joints at this refinery range in size from 1½" to 14".



UNDERGROUND...

Yarway Gun-Pakt Joints installed in manhole of new steam distribution line of large Eastern utility. 12 Gun-Pakt Joints 12" and 18" are installed in this line; scores of other Gun-Pakts up to 24" are used by this utility.

YARWAY

go for Gun-Pakt Expansion Joints

Engineers go for Yarway Gun-Pakt Expansion Joints because:

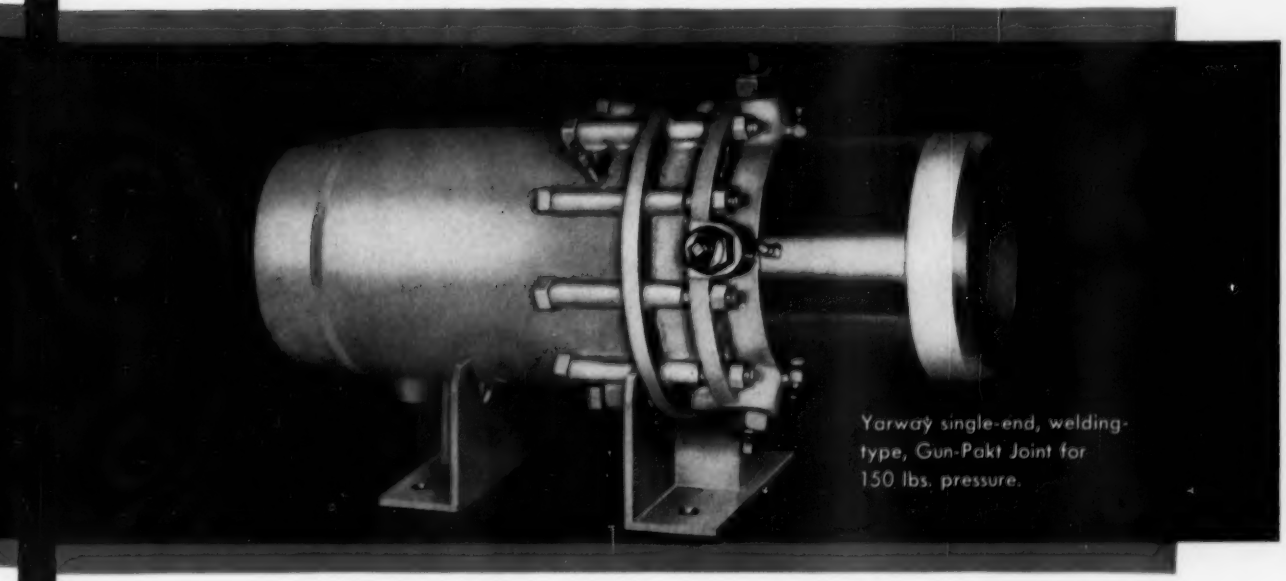
NO SHUTDOWNS. With Gun-Pakt Joints when new packing is needed, it is added under full steam pressure, right on the job—no unpacking, no shutdowns, no service interruptions.

FEWER JOINTS NEEDED. With Gun-Pakt Joints you need fewer joints per length of pipe line, with traverses up to 12″ single and 24″ double.

LONG SERVICE—NO METAL FATIGUE. Gun-Pakt Joints give long, trouble-free service life—no fatigue failures.

LOW MAINTENANCE. Maintenance records show the costs for servicing Gun-Pakt Joints are very low. One utility reports only 65 cents per year per joint—another reports less than half that.

Leading institutions, central heating stations and industrial plants "go for Gun-Pakt" again and again. Write now for latest bulletin EJ-1914.



Yarway single-end, welding-type, Gun-Pakt Joint for 150 lbs. pressure.

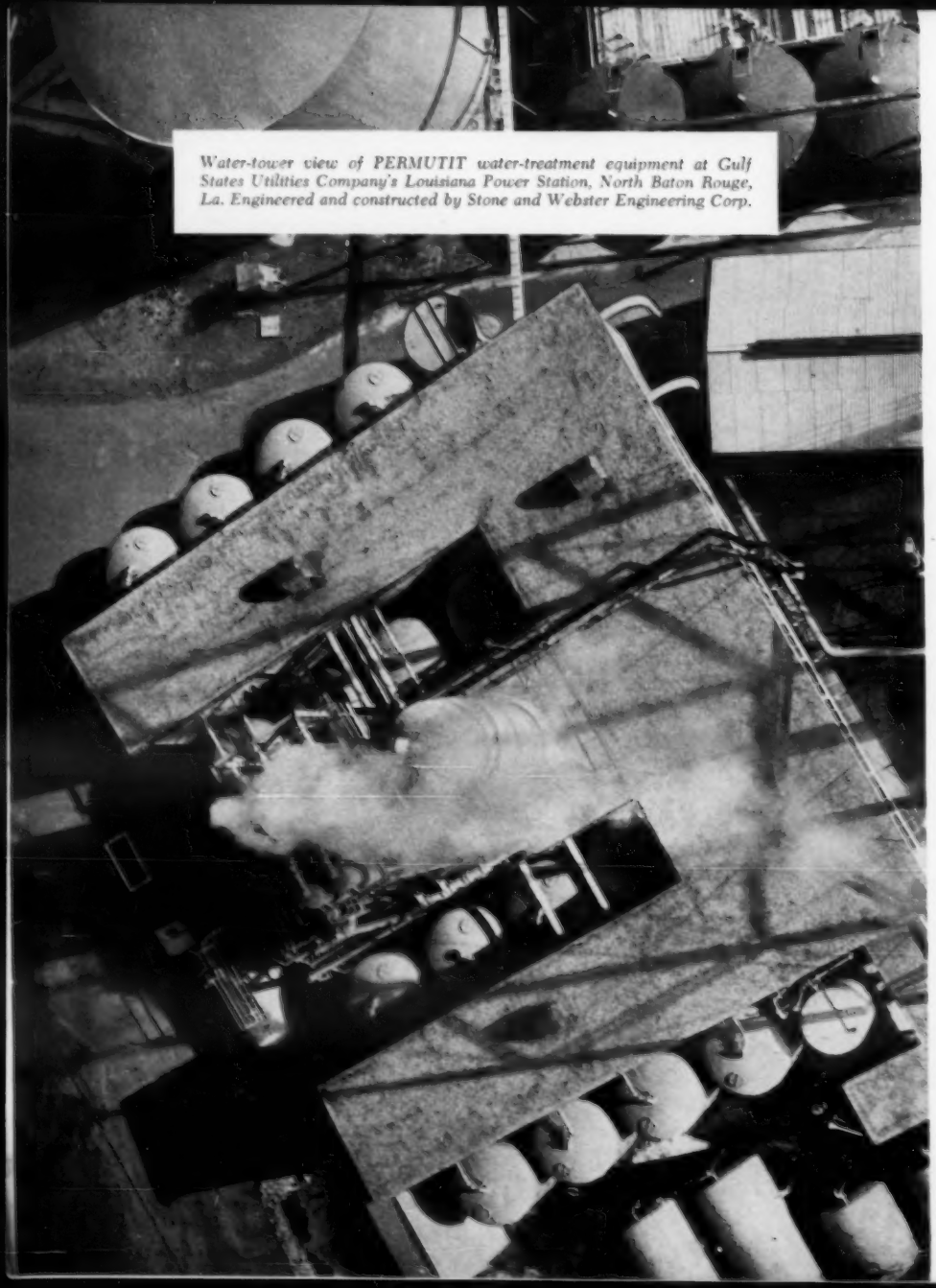
A few typical users of Yarway Gun-Pakt Expansion Joints

UTILITIES	INSTITUTIONS	INDUSTRIAL PLANTS
Detroit Edison Company	Central Heating Plant, Washington, D.C.	Ford Motor Co. of Canada
Georgia Power Company	Delaware County (Pa.) Prison	General Motors Corp. (Buick Division)
Ohio Edison Company	N.Y. Hospital & Cornell Medical Association	General Motors Corp. (Oldsmobile Division)
Rochester (N.Y.) Gas & Electric Co.	Purdue University	Westinghouse Electric Corp.
Pacific Gas & Electric Co.		
Philadelphia Electric Co.		

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Penna.
BRANCH OFFICES IN PRINCIPAL CITIES

GUN-PAKT EXPANSION JOINTS

For more data circle 506 on Post Card

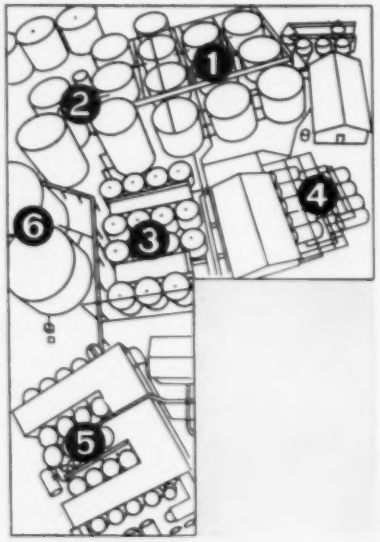


Water-tower view of PERMUTIT water-treatment equipment at Gulf States Utilities Company's Louisiana Power Station, North Baton Rouge, La. Engineered and constructed by Stone and Webster Engineering Corp.

12 million gallons of make-up per day

This station needs a *large volume* of water because it sells its steam to a refinery for process and requires 100% make-up. It needs *high-grade* water because it has adopted high-pressure boilers and turbines. It needs *efficient* treatment because it uses muddy Mississippi River water and well water with high solids and silica.

HERE'S HOW THIS 26-YEAR OLD PLANT HAS KEPT UP TO DATE *(see diagram):*



1. Original *batch coagulation and settling tanks.* Some are still used for secondary treatment of river water to reduce silica.

2. The 1931 roughing sedimentation tanks were converted to modern up-flow *Precipitators* in 1938 . . . cutting hardness 20%, turbidity 40%—and tripling capacity.

3. *Gravity filters* polish the clarified river water prior to softening.

4. Old Zeo-Dur® *zeolite softeners* were converted to new Zeo-Karb® exchanger in 1937 . . . boosting each unit's capacity 55%.

5. *Demineralizers* for new high-pressure boilers were added in 1955. They treat 3500 gpm, reduce dissolved solids of well water from 271 to under 2.0 ppm and silica from 25 to less than 0.1 ppm. Completely automatic PERMUTIT controls determine end-points, rinse, backwash and regenerate units and return them to service . . . even prepare regenerating solution.

6. *Tanks* store the high-quality, low-cost demineralized feedwater.

Whether you need one piece of water-treatment equipment . . . or acres of it, PERMUTIT has the know-how . . . earned by experience. This knowledge is at your service. Write The Permutit Company, Dept. PE-4, 330 West 42nd Street, New York 36, N. Y. or Permutit Company of Canada, Ltd., Toronto 1, Ont.

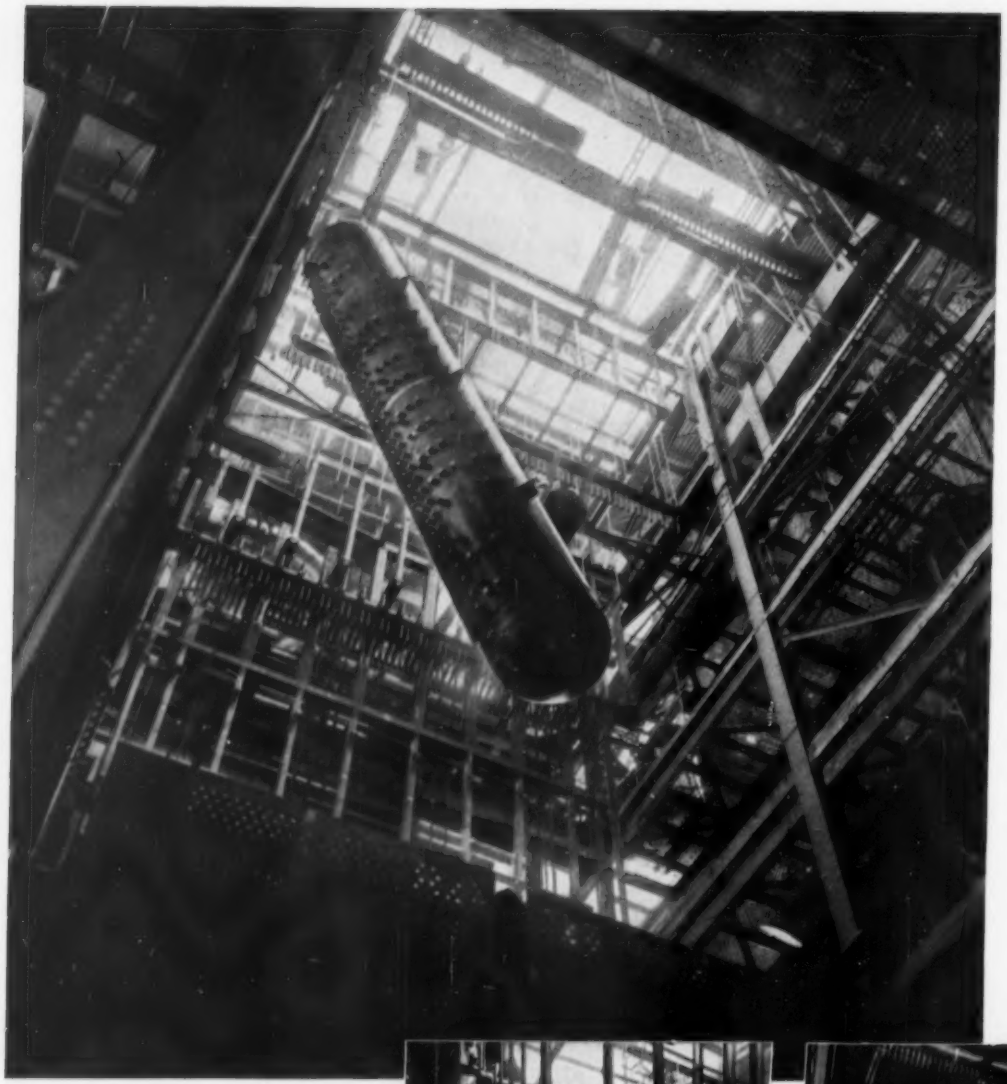
PERMUTIT®
WATER CONDITIONING
Equipment • Resins • Experience

Demineralizers • Zeolite and Hot-Process Softeners • Dealkalizers • Deaerating Heaters • Pressure and Gravity Filters • Chemical Feeders • Aerators • Blow-off equipment • CO_2 Indicating Recorders • Zeolites and Resins • Instrument Panels • Control Cubicles.

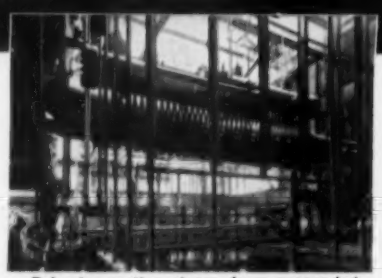
For more data circle 507 on Post Card

Progress Report

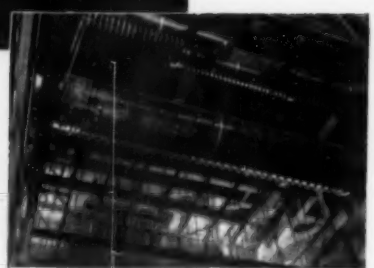
2,000,000 lb/hr



View looking upward in the reheater section, showing the 126-ton steam drum being raised into position. Shipped completely fabricated from Foster Wheeler's Mountaintop, Pa., plant, the first of the two steam drums arrived on the job-site on May 28, 1956 and was raised into position on June 1st.



Reheater section steam drum suspended in approximate position for final location, viewed from upper level.



Reheater section showing steam drum, headers and hangers in place, looking upward from 7th floor level.

on World's First

STEAM GENERATOR

Record-shattering FW steam generator for Detroit Edison's River Rouge Plant will deliver 8,620 btu per kwhr for 320,000 kw Unit No. 3

THE first steam generator ever designed to produce 2,000,000 pounds of steam per hour is now well under construction at Detroit Edison's River Rouge Plant. This huge FW steam generator, for 320,000 kw Unit No. 3, will also be one of the most efficient and economical units ever built. With a heat rate of 8,620 btu per kwhr, it will produce a kilowatt of electricity from less than ¾ lb of coal!

Designed for a pressure of 2700 psi, with 2450 psi and 1050F at the superheater outlet, it includes reheat facilities for resuperheating the steam to 1000F after it has passed through the initial stages of the turbine.

This single-unit FW steam generator consists of two separate sections, each containing a radiant superheater. All of the convection superheater surface is located in the "superheater section" and all of the convection reheater surface, in the "reheater section." Firing of the reheater section furnace is controlled to maintain 1000F reheat steam temperature, while the superheater section furnace is fired to maintain primary steam pressure. Primary steam temperature of 1050F is controlled by condenser-type desuperheaters.

The photographs included here show progress in the erection of this history-making FW steam generator at the River Rouge plant. This outstanding installation is another example of Foster Wheeler's ability to meet the most exacting requirements of modern power plant operation. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

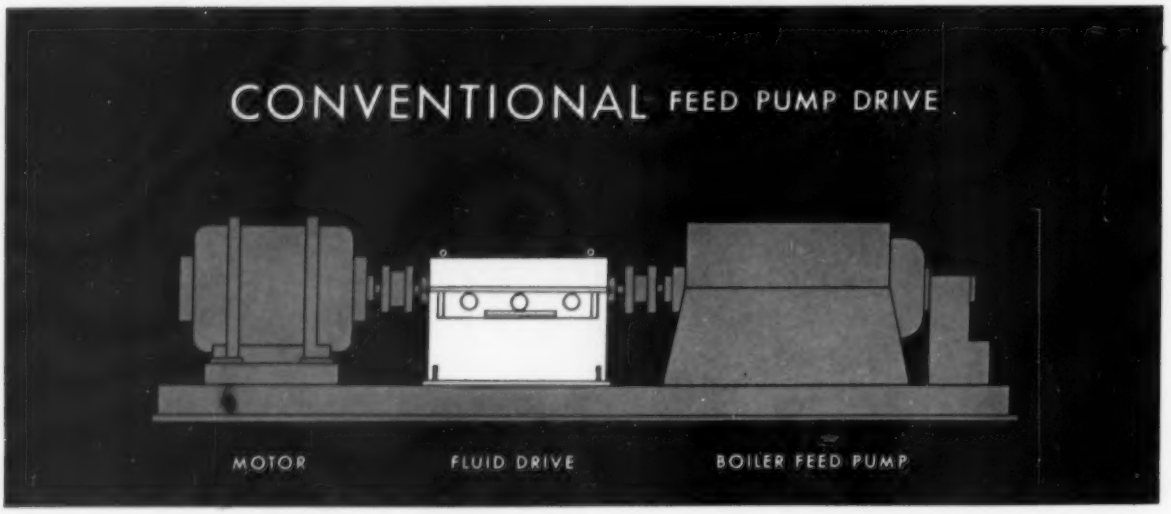
View of economizer space of the superheater section, looking downward from the 9th floor level.

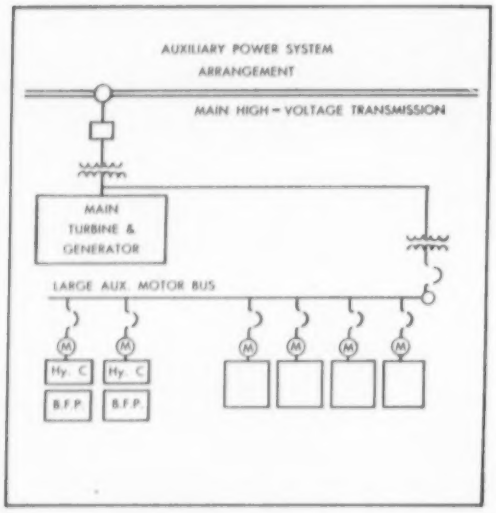
Reheater section economizer, also viewed from 9th floor elevation during construction.

Foster Wheeler's Construction Superintendent H. A. Shouse and Field Materials Coordinator A. K. Broome inspect radiant wall tiebacks.

For more data circle 508 on Post Card

How *Gýrol*® Fluid Drive meets all

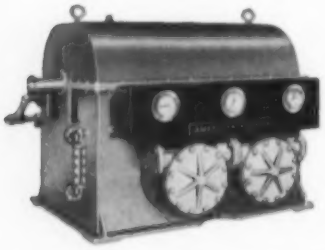




Of all power-plant auxiliaries, the boiler feed pump consumes the greatest single segment of invested power. To release more of this power to consumer lines, power plants of all sizes are controlling feed water flow by speed regulation through Gýrol Fluid Drive – driven by a constant speed prime mover.

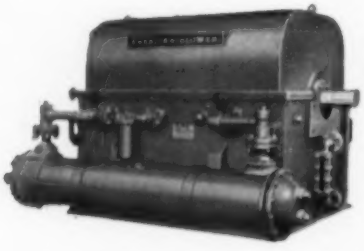
Gýrol Fluid Drive offers several specific advantages:

1. It saves power over the entire operating range by eliminating wasteful throttling by valves.
2. Fluid Drive's adjustable-speed feature permits reduction in pressure – resulting in further power savings.
3. It reduces wear on bearings, and other vital pump parts, by letting the pump operate at speeds that fit boiler demands.
4. With Fluid Drive, paralleling of pumps is simplified. Change-over from operating to standby pump is quick and easy.
5. Quiet operation is inherent in the design of Fluid Drive, since a "cushion of oil" is the means of energy transmission.



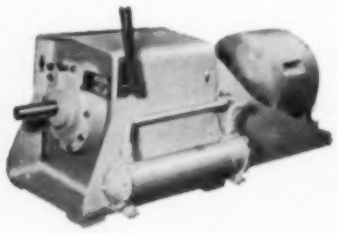
TYPE VS CLASS 6

- adjustable speed control
- 250 to 12,000 horsepower
- speeds to 3600 rpm



TYPE VS CLASS 4

- adjustable speed control
- 100 to 2500 horsepower
- speeds to 1800 rpm

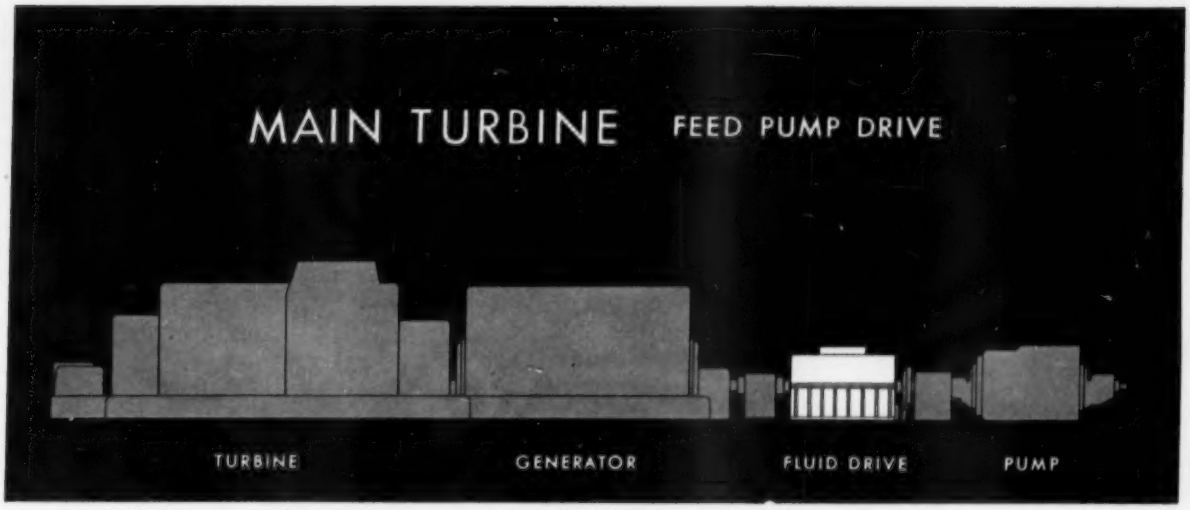


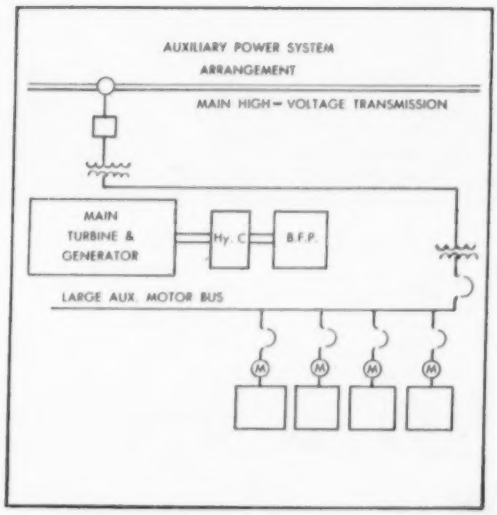
TYPE VS CLASS 2

- adjustable speed control
- 1 to 800 horsepower
- speeds to 1800 rpm

requirements for feed pump control

Regardless of station size, arrangement, or prime mover, you get the advantages of power savings, reduced pressures, and quiet operation with American Blower Gýrol Fluid Drives





Already in the construction stage is the use of Gýrol Fluid Drive for main turbine feed pump drives on some of the largest generating units yet projected.

For example, two of these stations will each drive, through a 12,000-hp adjustable-speed Gýrol Fluid Drive, the main feed pump from the high-pressure turbine. Full boiler capacities will be supplied by the single 5-stage pump, each delivering 6330 gpm against 6400 feet total discharge head when operating at 3510 rpm with feed water at 363° F.

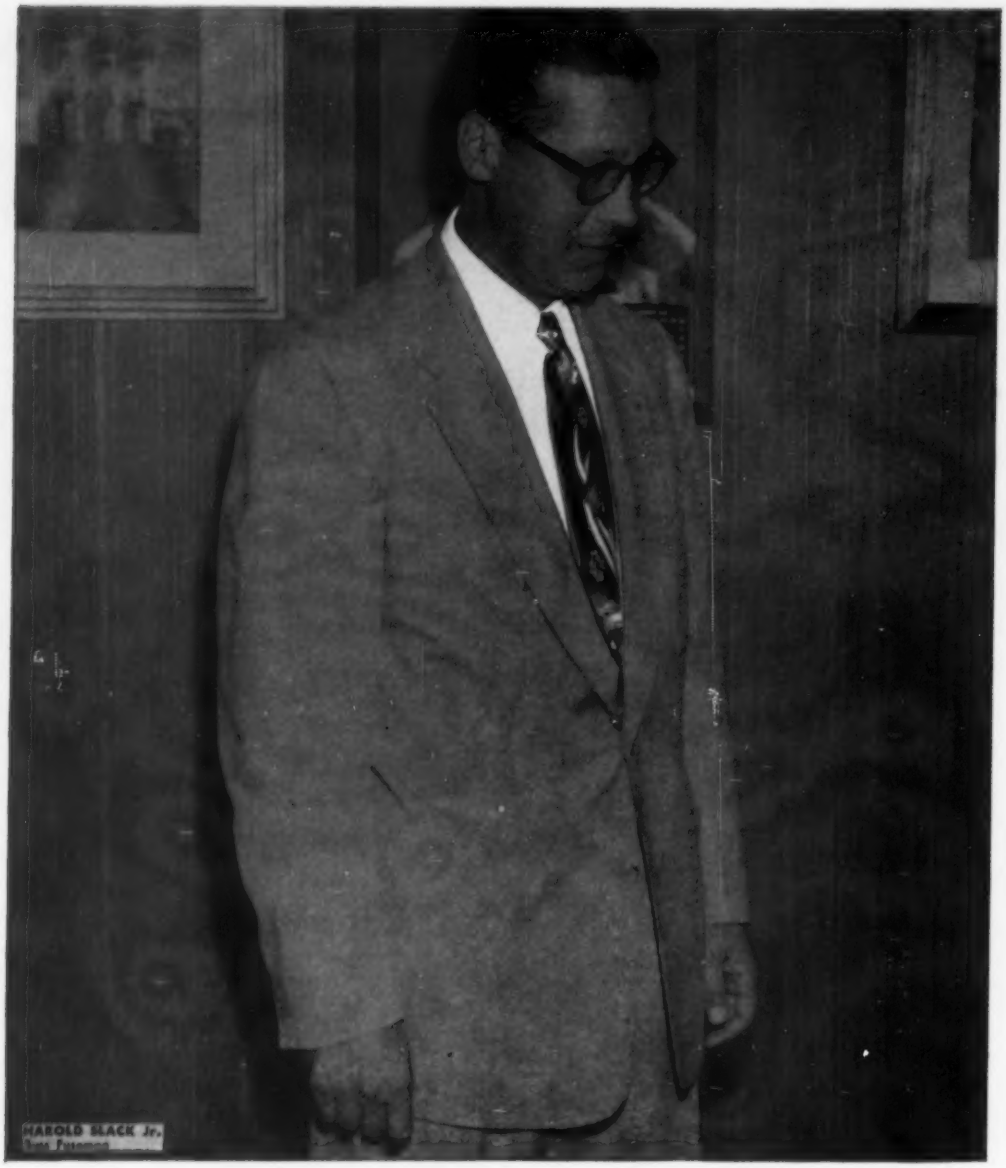
Each pump requires an excess of 11,000 hp, and will be driven from the generator shaft through an adjustable-speed Gýrol Fluid Drive.

In your plans for expansion, why not discuss the advantages of Gýrol Fluid Drive with an American Blower engineer. His knowledge of this application in modern power plants may prove valuable to you. Call our nearest branch, or write: American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

AMERICAN BLOWER

Division of American-Standard

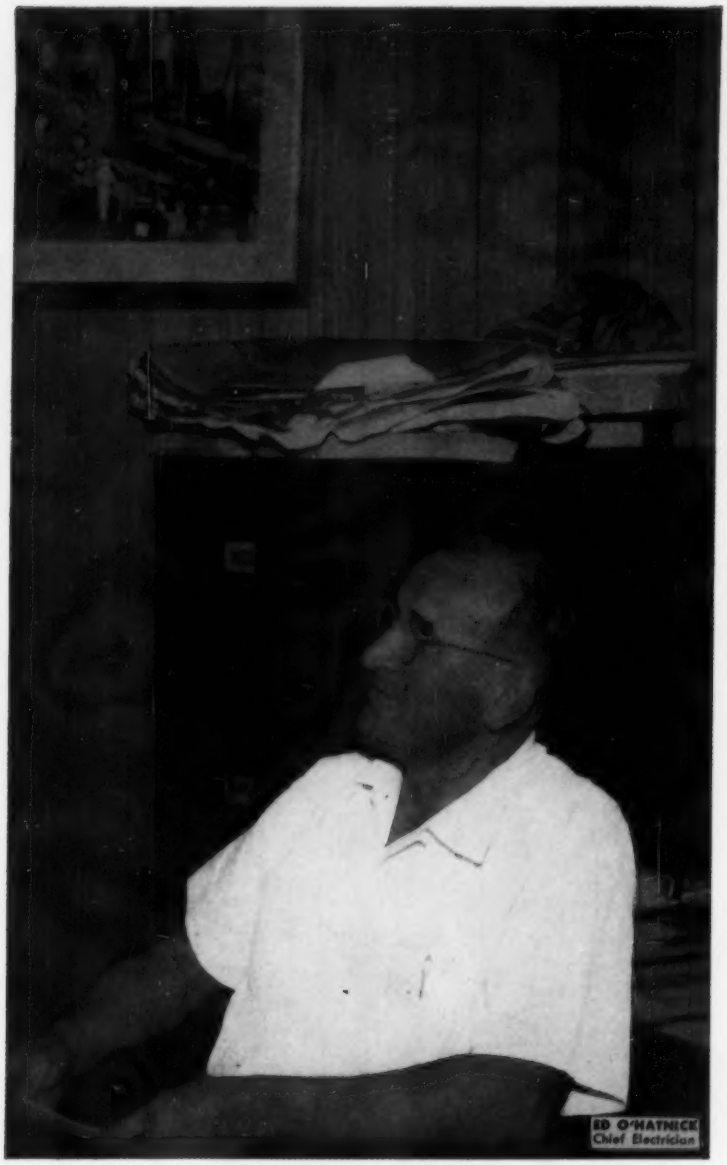
For more data circle 509 on Post Card



"By installing Fusetron Fuses . . .

We saved from $165 to $225 worth of solenoid coils a year and reduced down-periods"

ED. O'HATNICK, CHIEF ELECTRICIAN
FRANK KNEELAND PLANT, UNITED ENGINEERING & FOUNDRY CO.
PITTSBURGH, PA.



Mr. O'Hatnick continues . . . "The solenoids on the hydraulic clutches of our horizontal boring mills would sometimes stick or slow down when dirt got into the oil.

"When this happened, the tap D. C. solenoid coils wouldn't be pulled in far enough so they would burn up.

"Each coil cost about $15 and with 12 to 18 of them burning up every year it didn't take long for this to add to a considerable amount of money.

"And even more costly were the production losses that resulted from these shutdowns.

"With hope of reducing these expenses, we decided to individually protect the 72 solenoids in use with 3/10 ampere Fusetron dual-element fuses.

"In the next 3 years only 2 coils burned up.

"We had other favorable experiences with Fusetron fuses that convinced me they can make a plant more effective.

"That's why, upon being transferred to our Frank Kneeland Plant, I made a study to see where Fusetron fuses can be applied to help us reduce operating costs."

257

Here's why Fusetron dual-element Fuses protect solenoids, coils and transformers against burnout.

By installing the proper size Fusetron dual-element fuse, a solenoid can be protected. The Fusetron fuse will not open on the operating surge but will open in time to protect, should the heavy current continue too long for any reason.

A transformer or coil, likewise, can be protected because the long time-lag of the Fusetron fuse permits it to hold all normal current surges and harmless overloads—yet it will open to prevent burnout on any dangerous overload.

All you need to protect Coils, Transformers or Solenoids against burnout is a Fusetron fuse plus a fuse block or a BUSS fuse holder.

On voltages up to 125 the same dependable protection can be provided with a proper size Fusetron plug fuse or BUSS Fustat.

FUSETRON FUSES DO MORE THAN PROTECT SOLENOIDS AGAINST BURNOUT . . . ***They Provide 10 Point Protection*** **1.** High interrupting capacity—protect against heaviest short circuits. Have proven on tests to open safely on circuits set to deliver in excess of 100,000 amperes. **2.** Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation. **3.** Protect against needless blows caused by harmless overloads. **4.** Provide thermal protection—for panels and switches against damage from heating due to poor contact. **5.** Protect against waste of space and money—permit use of proper size switches and panels. **6.** Protect motors against burnout from overloads. **7.** Give DOUBLE burnout protection to large motors — without extra cost. **8.** Protect motors against burnout due to single phasing. **9.** Make protection of small motors simple and inexpensive. **10.** Protect coils, transformers and solenoids against burnout.

Write for bulletin FIS.

FOR LOADS ABOVE 600 AND UP TO 5,000 AMPS . . . USE BUSS HI-CAP FUSES! When coordinated with Fusetron fuses they will not open ahead of the fuse nearest fault.

Write for bulletin HCS.

Play Safe! *install FUSETRON dual-element Fuses and BUSS Hi-Cap Fuses throughout entire Electrical System!*

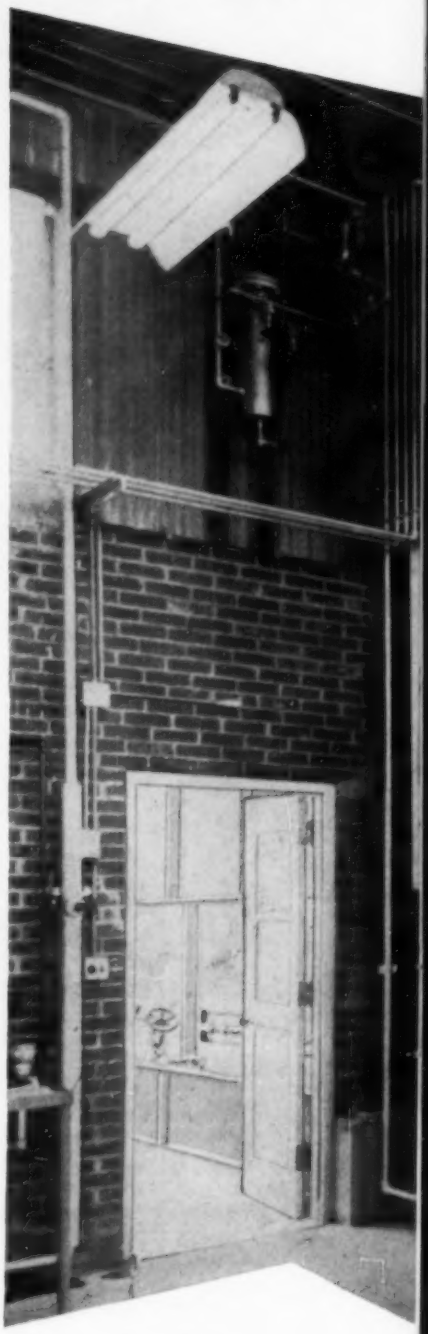
FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

BUSSMANN MFG. CO. *Div. of McGraw-Edison Co.*
University at Jefferson, St. Louis 7, Mo.

For more data circle 510 on Post Card

ERIE CITY

For Future---
Stoker Firing



• Now it's possible to obtain the advantages of completely packaged gas and oil fired steam generators and still provide for future stoker firing. Erie City VL's are designed as a true package with furnaces properly proportioned and arranged for easy conversion to stoker firing.

These Erie City VL type package steam generators are arranged for either forced or induced draft operation and are shipped shop assembled with brickwork installed. Controls and Burners are piped, wired and mounted — and remember — Erie City package boilers are Factory Fire Tested prior to shipment. All this ready for your basic service connections plus having a boiler designed for the future installation of an Erie City stoker. Write for Catalog SB-433D

2 Additional Units Now Installed

• *When American Synthetic Rubber Corporation of Louisville, Kentucky modernized its steam facilities, they turned to Erie City Packaged Power. Installed there are three 25,000 pounds per hour VL type packaged steam generators complete with Erie City steam atomizing combination gas and oil burners and arranged for the future installation of Erie City Underfeed Stokers.*

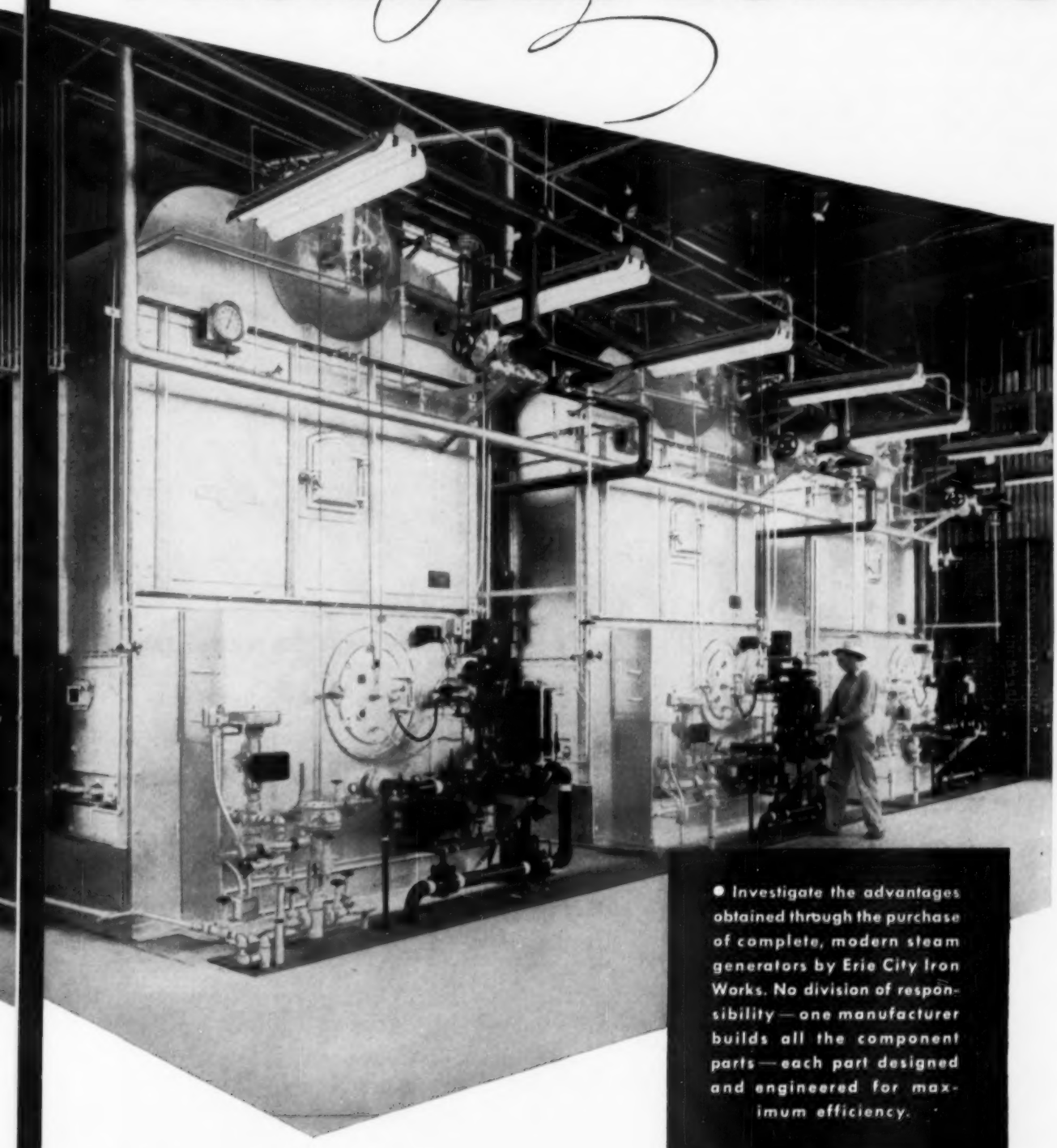
ERIE CITY
117 Years in Steam Generation

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

Oil and Gas
PACKAGED BOILERS



• Investigate the advantages obtained through the purchase of complete, modern steam generators by Erie City Iron Works. No division of responsibility — one manufacturer builds all the component parts — each part designed and engineered for maximum efficiency.

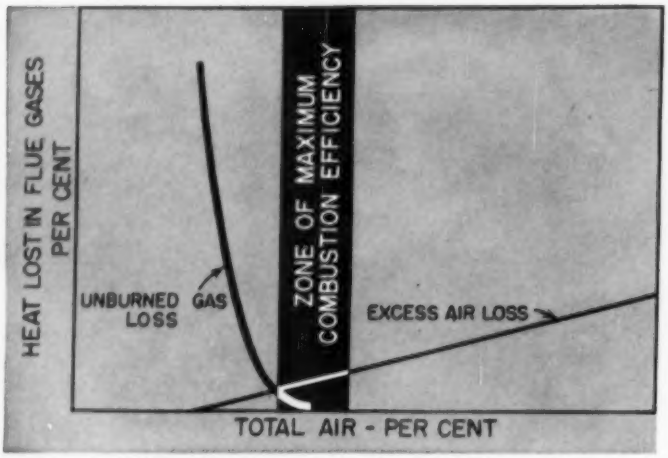
For more data circle 511 on Post Card

How to get maximum combustion efficiency . . . measure <u>both</u> combustibles and oxygen

Simultaneous measurement of both oxygen and combustibles is needed to obtain optimum combustion. No instrument that measures only one of these two interdependable factors can give you the full information necessary.

Now, Bailey offers two units, each giving a continuous and simultaneous double check on combustion efficiency: a permanent analyzer-recorder which records both factors on a single chart; and a new light weight, portable unit which indicates both factors.

Both instruments measure: (1) excess air—regardless of the fuel or combinations of fuel being burned, (2) mixing efficiency of your fuel burning equipment by showing per cent combustibles in the flue gas.


HEAT LOST IN FLUE GASES PER CENT
UNBURNED GAS LOSS
ZONE OF MAXIMUM COMBUSTION EFFICIENCY
EXCESS AIR LOSS
TOTAL AIR - PER CENT

Maximum Combustion Efficiency is secured by keeping the sum of Excess Air Loss and Unburned Gas Loss to a minimum. To do so by the direct method simply measure both oxygen and combustibles in flue gas.

Both units are designed to increase efficiency in the furnace operations of the steel industry, on glass tanks, cement and lime kilns, ceramic and refractory kilns, steam boilers and also on direct and indirect-fired furnaces in the metal processing industries.

To prevent your money from becoming waste gas, look into these two efficiency provers. A Bailey engineer will be glad to give you details or write us for product specifications.

For portable use—
HEAT PROVER Analyzer

The famous Cities Service HEAT PROVER analyzer is now Bailey built and sold. Weighing only 25 pounds, it is a self-contained automatic analyzer including a sampling tip and hose plus a thermocouple for temperature measurement.

Instrument dials are dual range for greater accuracy and sensitivity.

For permanent installation
Oxygen-Combustibles Recorder

The Bailey Oxygen-Combustibles Analyzer-Recorder coordinates both records on one chart. These records enable the operator to keep fuel burning equipment performing continuously in the zone of maximum combustion efficiency. Excess air may be reduced to the point where combustibles begin to show.

G 40-1

Instruments and controls for power and process

BAILEY METER COMPANY

1040 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS

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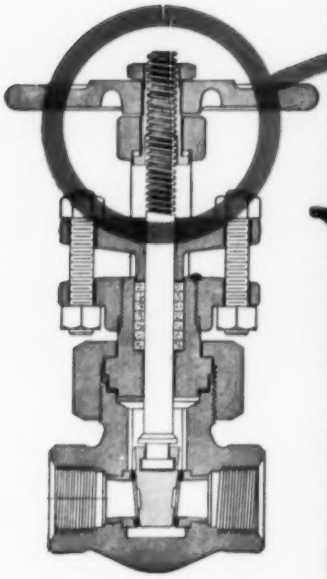

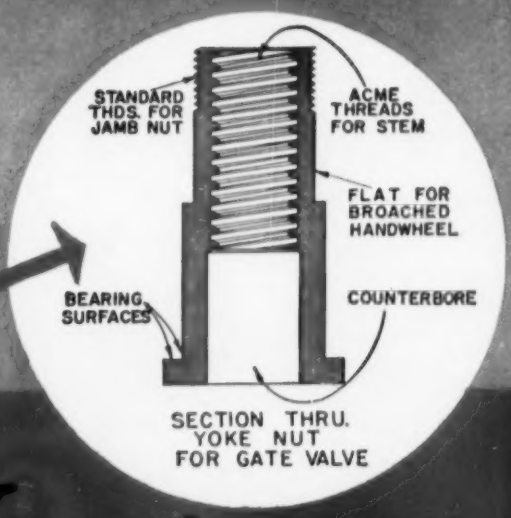

Vogt valves feature heat and wear resisting STAINLESS STEEL yoke nuts

Heat and wear-resisting *stainless steel* yoke nuts in Vogt Valves give longer trouble-free service. We have proved this in our own "Torture Chamber," under constant and accelerated testing, as well as in tough service applications. They are made from a special stainless steel alloy having excellent bearing quality, matchless strength, and a melting point of approximately 2700°F.

The rotating gate valve yoke nut design, illustrated, has flats for a tight fit with the square broached hole of the handwheel. Non-rotating yoke nuts, for globe and angle valves, are of the same superior design and quality. Vogt GP Valves are available in a complete range of sizes from ¼" to 2" and rated 800 pounds at 850°F. and 2000 pounds at 100°F.

Adv. No. 6 in a series describing the features of Vogt GP Valves.

Write For Your FREE COPY of Supplement No. 1 to Catalog F-9. Address Dept. 24A-FPE

HENRY VOGT MACHINE CO.
P. O. Box 1918—Louisville 1, Ky.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati.

Vogt GENERAL GP PURPOSE Vogt FOR BETTER VALVES

DROP FORGED STEEL

VALVES

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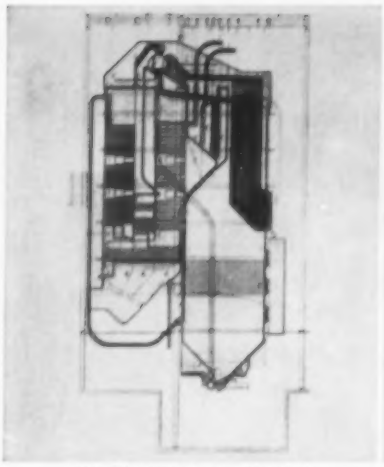
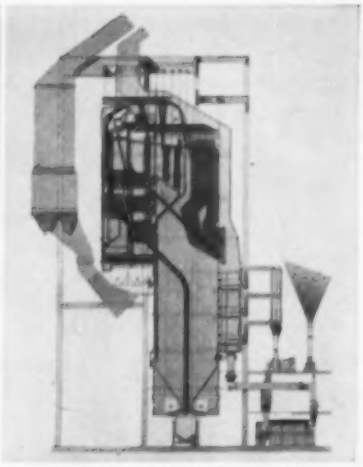


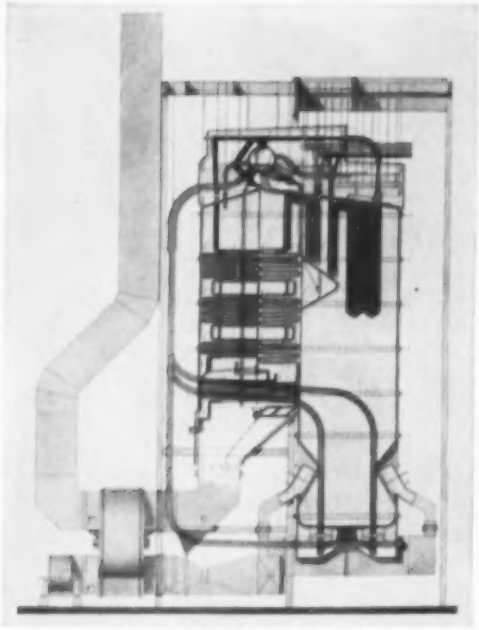
600,000 #, 1700 psi., 1000 F. Reheat



1,000,000 #, 2075 psi., 1005 F. Reheat

COMPARATIVE YEARLY BOILER SALES

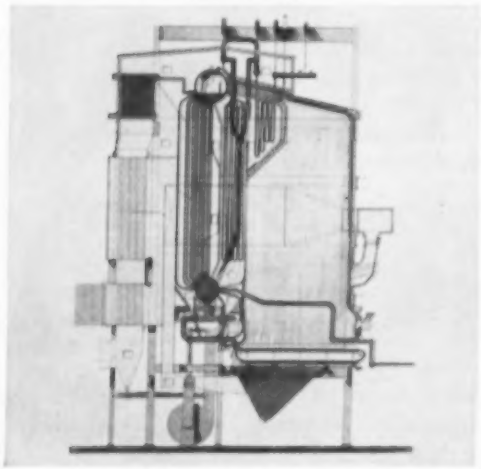
1956 BANNER



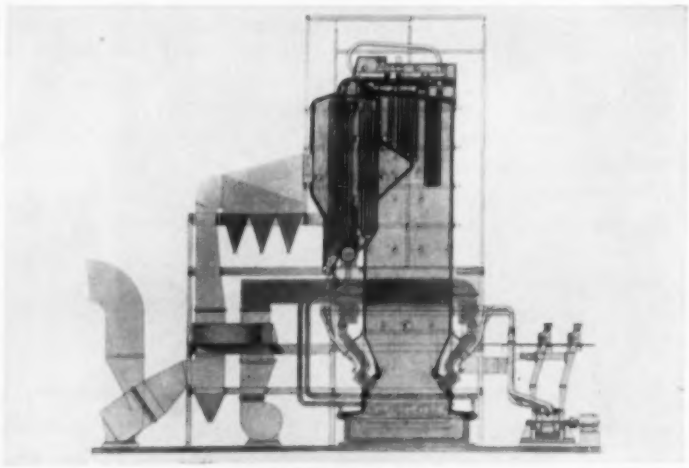
1,550,000 #, 2125 psi., 1005 F. Reheat
TURBO FURNACE

1956 sales of Riley central station and large industrial type boilers were the highest in Riley history. Contributing to this outstanding sales record is the unusual acceptance of the comparatively new Riley TURBO FURNACE, a unique design that provides solutions to a number of problems associated with the economics of fuel utilization.

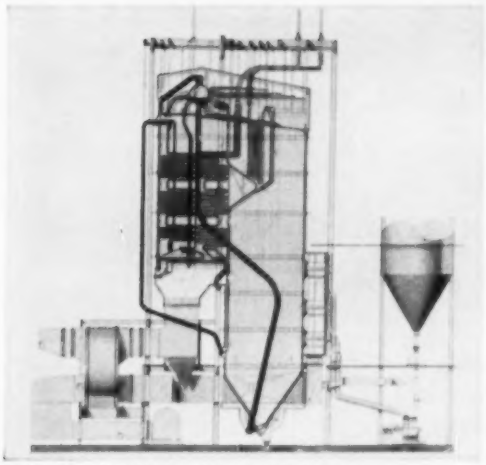
A large percentage of Riley's 1956 sales was to former customers that are completely satisfied with the continuity of operation, high rates of efficiency and dependability of Riley units purchased in the past. One prominent chemical producer ordered ten large boilers from Riley bringing its total number of Riley



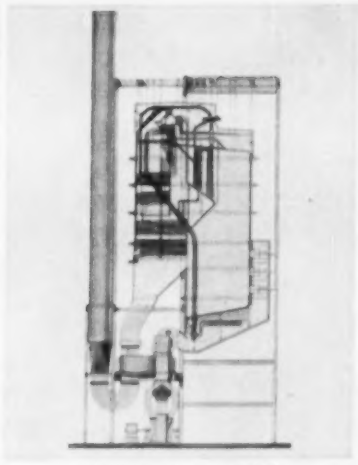
250,000 #, 1025 psi., 905 F.



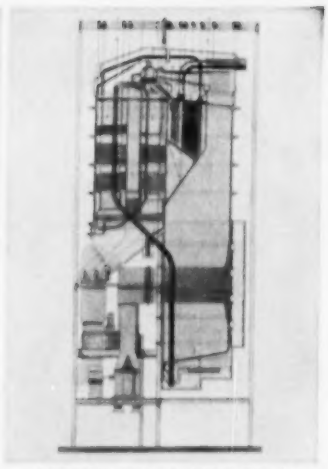
500,000 #, 1425 psi., 950 F.



580,000 #, 1725 psi., 1005 F. Reheat

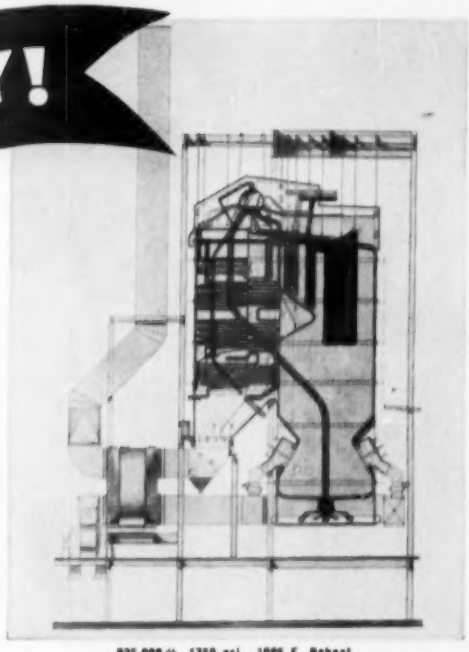


1,050,000 #, 1725 psi., 1005 F.



1,200,000 #, 2125 psi., 1005 F. Reheat

YEAR FOR RILEY!



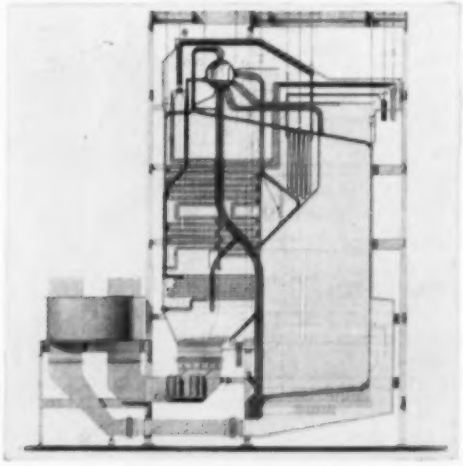
825,000 #, 1750 psi., 1005 F. Reheat
TURBO FURNACE

units to thirty-six, with a total steam generating capacity of 12,775,000 pounds per hour.

Most Riley units sold in 1956 include Riley Fuel Burning Equipment: Flare Type Burners, Riley Directional Flame Burners (with TURBO FURNACE units), Riley Intertube Gas/Oil Burners, Riley Pulverizers, Riley Spreader Stokers with Traveling Grates or with new Riley Oscillating Grates.

With today's fuel economics playing such a vital role in the selection of your steam generating equipment, you can rely on Riley for the solution to virtually any conceivable fuel situation.

Illustrations depict typical designs of Riley Central Station Units.



350,000 #, 1650 psi., 1005 F. Reheat

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

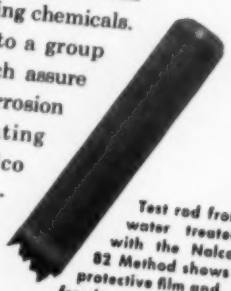
RILEY
Stoker Corporation
WORCESTER, MASSACHUSETTS

Sales Offices: Worcester, New York, Philadelphia, Buffalo, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver (Englewood), Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.

For more data circle 514 on Post Card

Forest of Facts on Nalco® RECIRCULATING WATER TREATMENT

NALCO Laboratories' continuous research program has gathered this forest of facts about protecting recirculating water systems. In the search for the most effective *and economical* formula, the metal rods shown have been rotated in all types of recirculating waters and treating chemicals. Results pointed the way to a group of Nalco Treatments which assure users against scale and corrosion in virtually any recirculating waters. For details on Nalco Treatment to fit your particular system, call your Nalco Representative, or write direct.



Test rod from water treated with the Nalco 82 Method shows protective film and freedom from any scaling or corrosive attack.

THE Nalco 82 METHOD MAY BE THE ANSWER FOR YOU

The Nalco 82 Method is particularly suitable for scale and corrosion control in recirculating water systems which fall within the characteristic limits given here. Check them to see if your system should have Nalco 82 Treatment:

- Equipment to be protected contains steel and/or brass.
- Hardness of makeup water is more than 50 ppm; and sulphates and chlorides, as sodium salts, are less than 150 ppm.
- Calcium hardness of makeup can be as much as 500 ppm.
- Silica content of makeup water up to 50 ppm.
- Total alkalinity of makeup more than 40 ppm.
- Recirculation rates between 100 and 100,000 g.p.m.
- Where non-toxic waste water is required.

Act today to get the certain, low-cost protection of The Nalco System. Full data on Nalco 82 in free Bulletin 68.

NATIONAL ALUMINATE CORPORATION

6224 West 66th Place • Chicago 38, Illinois

In Canada: Alchem Limited, Burlington, Ontario

THE Nalco SYSTEM . . . Serving Industry through Practical Applied Science

For more data circle 515 on Post Card

HELPFUL BULLETINS

LUBRICANTS

101 Valve Lubricant — Bulletin V-220, 12 pp, provides detailed lubricant selection data, including information on 80 new lubricants. Discusses such topics as functions of a lubricant, forms and types of lubricants, and methods of lubricating. Characteristics of various types of lubricants are tabulated on a chart, and lubrication equipment is described. Meter and Valve Div., Rockwell Mfg. Co.

102 Compressor Lubricant — Pydraul AC, a fire- and explosion-resistant fluid developed specifically as a lubricant for air compressors is the subject of Technical Bulletin 0-133. Physical properties and instructions for the conversion of compressors to its use are contained in the bulletin. Organic Chemicals Div., Monsanto Chemical Co.

PUMPS, COMPRESSORS

103 Industrial Pumps — An easy-to-use table for determining horsepower, capacity and head for vertical pumps is included in 12-pp Bulletin 1100. Also contains sectional views, material specifications, schematic application drawings, and photos of installations. Important pump features are illustrated. Layne & Bowler Pump Co.

104 Air Cooled Compressors — Bulletin AC-15, 16 pp, shows a complete line of small, air-cooled compressors for industrial, and other use. Both one- and two-stage compressors are covered, with working pressures ranging from 85 to 175 psi. Complete specifications for each model are given and two charts — one for figuring compressor needs and another showing estimated air consumption for 30 shop jobs — are printed. Gardner-Denver Co.

105 Air Compressors — This consolidated data sheet lists ¼- through 20-hp, single and two stage air compressors. Complete specifications are presented in tabulated form. Brunner Mfg. Co.

VALVES, PIPING, FITTINGS

106 Bronze and Steel Valves — Catalog 200, 80 pp, describes company's bronze and steel valves, including globe, angle, gate, Flocontrol and other types applicable to power, petroleum, chemical and general industry installations. Engineering data such as material specifications, flow charts, temperature and pressure ratings are included. The catalog is profusely illustrated with photos, cutaway views and dimensional drawings. Manning, Maxwell & Moore, Inc.

107 Hydraulic Valves — Entitled "High Pressure Hydraulic Valves," this 8-pp brochure lists and describes 24 different styles of company's valves for hydraulic systems, ranging from 1500 to 20,000 psi. It covers check valves, stop valves, operating valves and special purposes types. All similar valves are listed under single headings, and sizes available, working pressures and type of metal construction for every valve indicated. R. D. Wood Co.

108 Bronze Valves — Bulletin DH-25 describes solder end and silver-braze end bronze valves in gate, globe and check designs. Also included are physical characteristics and other details. R-P&C Valve. Div., American Chain & Cable Co., Inc.

109 Air Valves — Catalog V-103, 8 pp, introduces three new models to company's line of ¼-, ⅜- and ½-in. air valves. These four-way valves are available as single solenoid, or for foot or cam operations. Features of these valves are listed and dimensional drawings included. Catalog also shows other models of air valves and includes price list. The A. K. Allen Co.

110 Underground Pipe Conduit — Bulletin 9156, 12 pp, covers essentials pertaining to underground pipe conduit. Construction and installation of the conduit are detailed and results of strength tests and complete specifications are included, as well as photos of typical installations, dimensions, and design suggestions. Porter-Hayden Companies.

111 Tin-Lined Piping, Valves — Bulletin 139 describes company's line of tin-lined pipe, fittings, line valves, faucets and accessories developed to protect distilled or demineralized water from metallic contamination. Purified water may be piped throughout an entire building, from point of origin to point of use, bulletin states, with tin-lined piping and accessories. Barnstead Still & Demineralizer Co.

112 Flared Tube Fittings — Catalog 3410, 52 pp, presents company's Triple-lok tube fittings, made in brass, steel, stainless steel, and aluminum, in a variety of shapes including new swivel nut type and straight threaded fittings with O-rings for new SAE straight thread boss. Fully illustrated with photos and dimensional drawings, catalog discusses general features and includes pertinent engineering data. The Parker Appliance Co.

113 Hose Couplings — Bulletin 115, 8 pp, describes and illustrates heavy duty high pressure hose couplings. Covers application in conveying high pressure air, steam, gas, hydraulic and liquid anywhere in construction, mining, petroleum and general industry. Capacity and size data included. Le-Hi Div., Hose Accessories Co.

INSTRUMENTS, CONTROLS

114 Guide to Automatic Controls — Described in this 56-pp Catalog 857 on automatic controls are some 100 items, all featuring hermetically sealed mercury contacts. Catalog lists controls for single-stage pressure, two-stage pressure, differential pressure, single-stage temperature, two-stage temperature, liquid level and mechanical movement. Also shown are relays and a mercury switches. Each control, with accompanying description, specifications and data can be located by a dual index. The Mercoid Corp.

115 Electric Temperature Control — How to select proper controls for heating and ventilating systems in today's schools and institutions is discussed and illustrated in non-technical language in 16-pp Booklet F 7773. Illustrated with photos and diagrams, the booklet covers the control of convector systems, direct fired warm air systems, zone systems, unit ventilators, and the application of control centers. Barber-Colman Co.

116 Pneumatic Control Stations — Eight-pp Bulletin 1031 describes new automanual pneumatic loading stations of the non-seal type. The mechanisms are suitable for use as components in combustion control, feed water regulation, pressure-reduction systems, desuperheating stations and other regulation and control duties in steam power plants. Both standard size and miniature devices are described. Copes-Vulcan Div., Blaw-Knox Co.

117 Pneumatic Computing Relay — Four-pp Product Specification P99-3 describes features, application, and operating characteristics of a computing relay for pneumatic control systems. Explains proportional, reset, and rate control actions, and provides equations of computing actions. Bailey Meter Co.

118 Oil-Tight Pushbuttons — Illustrated in full color, 30-pp Publication EL-178 presents company's line of oil tight pushbuttons, indicating lights, selector switches, Roto-Push buttons, covers and enclosures and accessories. All models are pictured along with selection charts, ordering information. Dimensional data included. Compactness, flexibility, durability and neat appearance of the push buttons are discussed. Cutler-Hammer, Inc.

119 Guide to Push Buttons — How to select right push button for every application is told in 32-pp Catalog 5600 A, covering oil tight and general purpose push buttons, pilot lights and accessories. Provides description of components and complete units, dimensions, cam action and schematic diagrams. Furnas Electric Co.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 139 and 140.

120 Meters, Valves, Regulators — Catalog C-5000 Rev 8, 28 pp, includes photo-illustrated descriptions of the recently introduced telapilot — with power pilot loading by remote control — and the Hypregun, a light, compact, efficient air-operating valve lubricant gun. The catalog also includes revised specifications. Meter and Valve Div., Rockwell Mfg. Co.

121 Conversion Chart — Tables of Fahrenheit and Centigrade temperature equivalents are presented in this handy temperature conversion chart. Its reverse side illustrates, by means of animated demonstration, the easy reading qualities of company's thermometers with glass red reading column. Moeller Instrument Co.

WELDING, MACHINE SHOP

122 For Notching Tube Pipe — This 24-pp catalog describes production

and economy advantages of company's machine for notching tube and pipe to make joints for welding. Text is illustrated with large photos showing complete operation, and specifications are included. With the catalog, comes a sample of finished product. Wallace Supplies Mfg. Co.

123 Arc Welding Electrodes — Included in data presented in this 24-pp electrode data book are: information on AWS-ASTM arc welding electrode specifications; how to estimate electrode consumption; summary of welding symbols; factors in selecting electrodes and other data of interest to users of arc welding. A table of welding characteristics of mild steel electrodes is also provided, as well as recommended current for various types of electrodes. National Cylinder Gas Co.

ELECTRICAL

124 Motor Selection — Twelve-pp Application Guide 102 makes it easy to choose electric motors for many common applications. You select from tables the kind of equipment or machinery to be driven — then identify character of load, speed of operation, starting and running torques, surrounding atmosphere, frame type and speed to arrive at right motor for application. Dimensions and other pertinent data are provided. Line covered includes 1/20 to 400 hp motors, polyphase, single phase, d-c types. Century Electric Co.

125 Servo Motors — Bulletin 385, 10 pp, gives characteristics, drawings, and application data on standard and custom servo motors. Data includes complete electrical and mechanical specifications, application data on direct plate to plate, transistorized servo amplifier, and magnetic servo amplifier. Norden-Ketay Corp.

126 Voltage Regulators — Construction and operating features of "Rocking Contact" voltage regulators (Types A, B, and C) for alternating current generators up to 25,000 kva are described in Bulletin 14B6035C. Installation procedure is diagrammed and seven reasons why regulators give accurate, dependable service are listed. Allis-Chalmers Mfg. Co.

127 Switchgear Maintenance — "Guide to Metal-clad Switchgear Maintenance," 8-pp, outlines a product maintenance program for medium voltage, metal-clad type switchgear and air-magnetic and oil-filled types of power circuit breakers. This publication (No. GER-1282), includes photos which depict various phases of inspection and maintenance, and contains a quick-reference trouble-shooting chart. General Electric Co.

128 Load, Frequency Control — Bulletin B91-1, 24 pp, describes all-electronic load and frequency control systems for captive plant, small utilities, and multiple station systems. Although each control system is custom-planned, this bulletin describes individual servos that form an interlocking, continuous chain for the cumulative control of all factors, from ties to generators. Included are electrical servomechanisms for area requirement computer, control circuit, positive governor adjustments, others. Minneapolis-Honeywell Regulator Co.

129 Indoor Circuit Breakers — Bulletin GEA-6465, 16 pp, describes outstanding features of indoor oil circuit breakers. Contains pictures and drawings of four types of indoor oil circuit breakers; application information, and charts which list ratings, insulation levels, and interrupting capacities of the equipment. General Electric Co.

130 Current-Limiting Reactors — Design and application data on current-limiting reactors are available in 16-pp Bulletin GEA-976D. Describes line of RM (repetitive manufacture) cast-in-concrete reactors for circuits of 34.5 kv and below. Ratings, dimensions and weights are given for reactors designed to fulfill all normal requirements in the 5- and 15-kv classes. One-line circuit diagrams show locations where reactors can economically provide overcurrent protection for system expansion. General Electric Co.

131 Electrical Connectors — This connector reference file features data on electrical connectors in readily usable form. Each sheet in the series is devoted to a connector type used in power transmission or distribution. Illustrated with photos and drawings, it includes brief descriptions of connector applications and design features. Burndy Corp.

132 On Meter Buying — The 1957 Meter Buyers' Guide — Bulletin GEC-1400, 64 pp — covers essential information on company's single-phase, polyphase and watthour demand meters, as well as water heater time switches and meter sockets. Complete specifications, ratings, application diagrams, dimensional diagrams, and photos included. General Electric Co.

133 Cable Insulation — Bulletin 1106 is a 28-pp booklet explaining the four most-used methods employed in applying insulation to electrical conductors. Describes in easy-to-read language the advantages and disadvantages of each. Tips on cable selection are included. The Okonite Co.

134 Panel Wiring Techniques — Bulletin S-301, 8 pp, outlines methods for simplifying wiring operations for electrical and electronic equipment by use of raceways and pre-cut wires. It points out ways to improve appearance, describes, in pictures and text, procedure for installation, and how corners and T's are made. Specifications, part numbers and sizes are included. Stahlin Brothers, Inc.

HEATING

136 Improved Space Heaters — Sixteen-pp Bulletin 564 introduces the Counterflo space heaters with induced draft Pyrojet burner designed to burn gas, light or heavy oil, or combination gas and light oil. Burner and other components are discussed in detail. A large cutaway drawing shows construction and operating features. Specifications and dimensions are provided, also an explanation of how recirculation method utilized distributes heat at working level. Dravo Corp.

137 Feed Water Heaters — Bulletin 117-A, 12 pp, describes open coil tray-type feed water heaters designed to heat water to a higher temperature in less space. Covers both deaerating and non-deaerating types, with capacities of 3,000 to 300,000 lb per hr. Includes facts on what a feedwater heater does, how heaters are rated, function of a vent condenser, and counter flow principle. Stickle Steam Specialties Co.

MATERIALS HANDLING

138 Screw Conveyer Components — Six-pp Folder 2489 describes related ball bearing equipment being added to company's screw conveyor component line. Low starting friction and free-rolling action of these ball bearing components are discussed. Technical data on selection and application of Quik-Link conveyor screws, trough ends and hangers are provided, as are "get over and around" examples of how drive-end space problems can be solved. Link-Belt Co.

139 Bushed Roller Chain — Book 2454, 16 pp, contains a complete presentation of features of company's LX8 roller chain, along with application and selection information. Chains for power transmission and for conveyors and elevators, as well as attachments for the latter are covered. Dimensions, weights strengths and other data included. Link-Belt Co.

140 Rotary Feeder — Six-pp Data Sheet DVc describes company's Type B rotary feeder for heavy duty materials handling applications. Construction features that permit regulated quantities, accurate feed and positive shutoff in handling dry, free-flowing granular and pulverized solids are detailed, and photos and cutaway drawings included. Tables for selection of sizes and capacities are also given. The Allen-Sherman-Hoff Co.

141 Motor Scraper — Design, engineering, construction and operating features of company's motor scraper for large projects are described in Catalog MS-1104. Augmenting text matter are pictures and illustrations that help clarify design and operation. Specifications are also included. Allis-Chalmers Mfg. Co.

METALS

142 Corrosion Resistant Metal — Power engineers concerned with problems of corrosion and high temperature services will benefit from the technical data in Bulletins ASL No. 285 and ASL No. 286. ASL No. 285 offers information on company's Croloy 27–4–1 (Type 329) in tubular form, and ASL No. 285 furnishes data on Croloy 25–12 (Type 309S). Includes chemical analysis, size and range specifications, mechanical properties, welding characteristics, applications. The Babcock & Wilcox Co.

143 On High Temp Problems — Reprint TR-544 covers high-temperature problems in process plants. The report discusses the use of steel and its various alloys, and the mechanical and physical reactions of the materials under various temperature and corrosive environments. The Babcock & Wilcox Co.

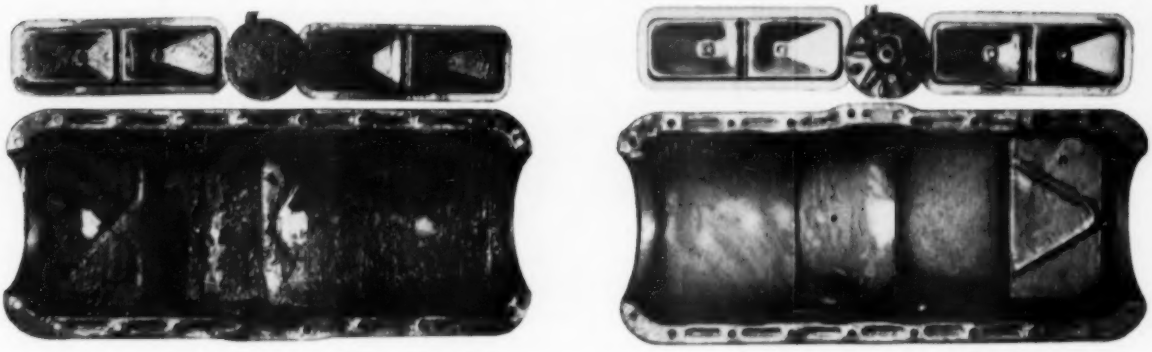
COOLING, EXCHANGING

144 Refrigeration Unit — Bulletin C-1100-B95 announces a hermetic centrifugal refrigeration unit, in 100- to 500-ton capacities, designed to meet any air conditioning installation requirement where chilled water is used. Gives information on component parts, features and specifications. Worthington Corp.

145 For Generator Cooling — Twelve-pp Bulletin 1200, on recent developments in coolers for generator windings, describes design and construction of G-R K Fin coolers, finned tube units for both air and hydrogen circulated through the generator windings in a closed system. Application of each type of unit is shown and explained. Reference is made to applications of these coolers to air and gas cooling

PROOF POSITIVE...

of SINCLAIR Diesel Oil Superiority!



This is actual photographic proof of the superiority of Sinclair Diesel Lubricants. On the left is a truck engine sump in which an ordinary oil was used. The clean sump on the right reflects conditions when a Sinclair Diesel Oil, SUPER TENOL, was used. This same top quality lubrication performance can be expected from all Sinclair Diesel Oils . . . *because Sinclair has the exact oil to match your engine's requirements!*

Sinclair RUBILENE® – These high viscosity index oils, refined by Sinclair's famed Phetone Process, have a long history of outstanding performance and are extensively used in stationary Diesel power plants today.

Sinclair RUBILENE HD – These high viscosity index oils contain additives which provide excellent detergent – dispersant properties, oxidation resistance, bearing corrosion prevention and anti-foam qualities. They are especially suitable for stationary Diesels as well as the higher speed Diesels used in industrial plants.

Sinclair GASCON® –These naturally detergent, straight mineral oils are recommended for slow, medium and high speed Diesels where carbon deposits, engine cleanliness and easy, low temperature starting is important.

Sinclair GASCON HD – Heavy duty detergent type oils compounded with selected additives to provide extra detergent dispersant properties, bearing corrosion prevention, oxidation resistance and anti-foam characteristics.

Sinclair TENOL®, SUPER TENOL and TENOL EXTRA – A series of heavy duty, detergent–dispersant type, high viscosity index oils refined by the Sinclair Phetone Process. Recommended for all high speed automotive fleet Diesel engines, and for some engines of late design in stationary, portable and marine service. All three series contain varying degrees of additive concentrations necessary to give outstanding performance no matter what the service condition under which your Diesel operates.

For further information about Sinclair's trouble-proof Diesel lubricants, see your Sinclair Representative, or write Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. *There's no obligation.*

SINCLAIR

DIESEL OILS

For more data circle 516 on Post Card

COOLING TOWER POWER
is most efficiently utilized by
Marley
Multi-Blade Aerfoil Fans

Marley fans are unexcelled for the job of converting applied power to actual cooling performance, but the qualities that make them positively distinctive are ultra-smooth operation and long-life durability. It requires just two words—MULTI-BLADE and AERFOIL—to point out the characteristics that produce these stand-out advantages.

Watch a 22-foot, 12-blade Marley fan operate; listen to it operate. The customary "huff and puff" pulsation of large fans is not there. There is no structure-shaking vibration. The result? Longer life for speed reducer, drive shaft, fan cylinder and structure. That is the multi-blade advantage.

The Marley fan is inherently rugged and durable. Each blade is a single casting, a rigid, homogenous unit of specially selected aluminum alloy that retains its aerfoil shape permanently. Marley fans never develop tip-sag or service flutter. The design completely eliminates weld and rivet failures, skin cracks, imperfect laminations and internal corrosion.

All machine operations on Marley blades and hubs are carefully quality controlled. Blade surfaces are protected by a double-coated baked plastic finish. Each fan is balanced at the factory and match-marked for field assembly.

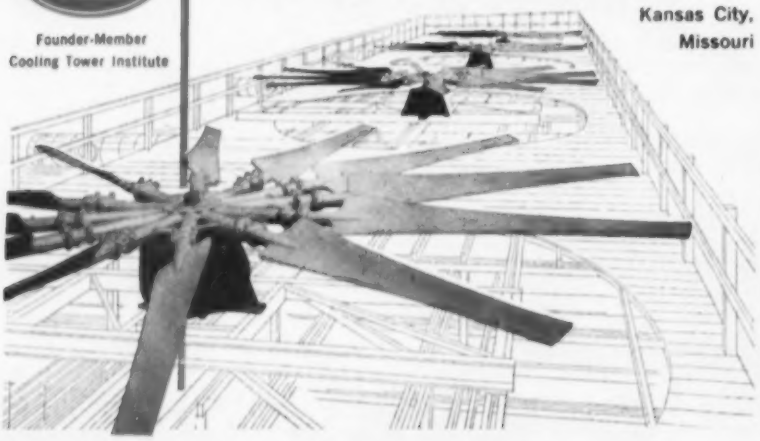
Owners of towers of all types and makes are modernizing their equipment by changing to Marley Multi-Blade Aerfoil Fans—often after side-by-side comparative test with present equipment. Write for Bulletin FH356 and get the complete story of modern design applied to cooling tower fans.

MARLEY

Founder-Member
Cooling Tower Institute

The Marley Company

Kansas City,
Missouri



For more data circle 517 on Post Card

or heating services in chemical process and other industrial plants. The Griscom-Russell Co.

146 Heat Exchange Surface — Advantages and applications of Thermo-Panel Coil — a plate coil heat exchange surface that takes the place of pipe coils in industrial heating and cooling processes — are described in Bulletin 257. Technical data included. Dean Thermo-Panel Coil Div., Dean Products, Inc.

. . . *Outstanding Among This Month's Catalogs*

147 Propeller Fans — Pictorial Bulletin FM-2345, 24 pp, describes design and fabrication of heavy-duty propeller fans and related package units. Covers various types of power roof ventilators, water coolers, heat pump installations, dual service condenser, and evaporator packages, fan assemblies for dry coil condensers, air washer and scrubber installations, stainless steel equipment for corrosive conditions, and others. Sizes, capacities and construction data given. Buffalo Forge Co.

148 Substation Library — Seven publications comprising a Unit Substation Silver Anniversary Technical Library are available to qualified power engineers. The publications are: "Distribution Substations in System Planning," GER-1151; "Economical Size Substations for 12-kv Distribution," GER-1299; "Converting a Radial to a Primary Network Distribution System," GER-1313; "Master Unit Substations and Their Relay and Control Arrangements," GET-2528; "Integrating Substation and System Planning Requirements to Reduce Over-all System Investment," GET-2677; "Twenty-Five Years of Progress in Unit Substations," GEZ-1865, and "Use of Handbooks for Substation Planning Purposes," GEZ-1867. Complete details of distribution systems are presented, along with engineering data, photos, diagrams. General Electric Co.

149 For Maintenance Construction — Materials for industrial maintenance and construction are described in this 20-pp catalog, including brickwork caulking, masonry dampproofing, rubber expansion joint materials, masonry exteriors, concrete admixtures, colorful concrete floors, and concrete coatings. Descriptions of the products, as well as uses, specifications and application information are included in the catalog. A. C. Horn Companies, Div. Sun Chemical Corp.

150 Industrial Silencers — Industrial and other silencers are described in detail in this 24-pp catalog. Applications of the various types of silencers are detailed, as well as construction features and installation. Dimensions, design principles, photos of typical applications, and other data on industrial silencers are included. Kittell Muffler & Engineering Co., Inc.

OTHER EQUIPMENT

152 Insulating Oil Purification — Bulletin 10-107 describes centrifugal insulating oil purifiers designed to keep insulating oil free of water and sediment.

Traveling Stocking and Reclaiming Coal Handling Tower OF WELDED DESIGN

a Mead-Morrison development

All connections in the main structure of this tower, both shop and field, are welded. The cantilevers employ riveted connections and are fastened to the main structure by means of rivets.

This modern design is typical of Mead-Morrison pioneering in developing stronger and more economical material-handling equipment. Write for complete information on Mead-Morrison Towers and Bridges for coal, ore and other materials.

Coal is brought to the plant of a large West Virginia steel mill in cars which dump into a digging pit alongside the Mead-Morrison tower. Unloading of the cars is aided by a car shakeout suspended from the side of the tower.

The tower digs coal from the trough and delivers it to the near-side stocking pile at the rated capacity of 915 tons per hour, and to the far-side stocking pile at the rated capacity of 610 tons per hour.

The tower also reclaims coal from the storage piles to the receiving hopper in the tower at the rated capacity of 765 tons per hour from either pile.

Included in the Mead-Morrison equipment are a 6½ ton light-weight grab bucket and automatic rail clamps to protect the structure in a high wind. Adjustable voltage is used for the hoist, close and trolley motions, and constant voltage for the propelling motors.

MEAD-MORRISON

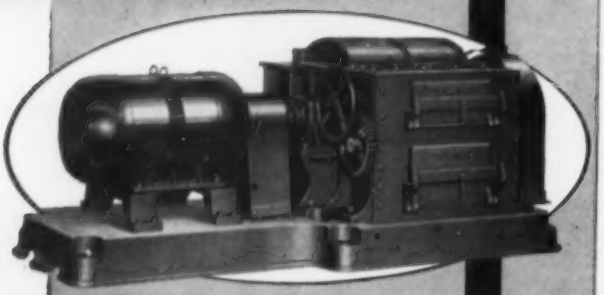
Division of McKIERNAN-TERRY CORPORATION

MANUFACTURING ENGINEERS

Harrison, New Jersey • Plants at Harrison, N. J. and Dover, N. J.

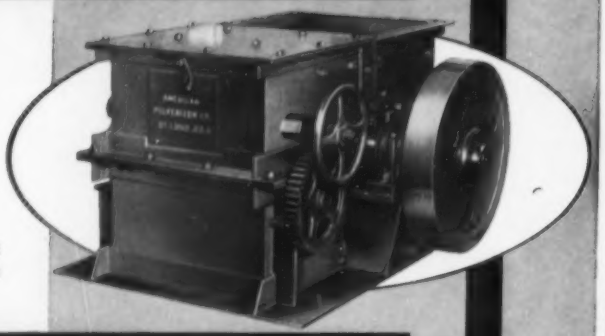
For more data circle 518 on Post Card

When You Figure . . .



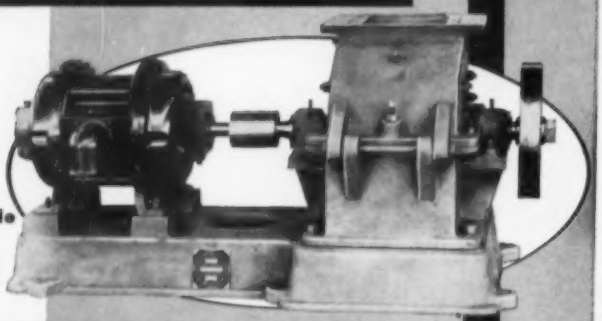
AC Series
capacities to
800 TPH

Reduction Cost Per Ton . . .



WC Series
capacities to
90 TPH

the Best Answers*. . .



Coal Sample Crushers
capacities to
2000 Lbs.
Per Hr.

Come from *American* Ring Coal Crushers

*In a recent independent survey, it was found that American Crushers reduced over 61,000,000 tons of coal at a parts replacement cost (including standby parts) of *less than 1/10th of 1¢ per ton.*

THERE CAN BE NO BETTER PROOF OF AMERICAN QUALITY!

American PULVERIZER COMPANY

WRITE for Literature on These Crushers

1421 MACKLIND AVE. • ST. LOUIS 10, MO.

For more data circle 519 on Post Card

Explains how these purifiers work and gives complete dimensions, capacities and specifications on the various types and models. Also shown are photos of typical installations. The De Laval Separator Co.

153 Mechanical Packings — Popular mechanical packings used on many applications in industrial, power and processing plants are listed in this illustrated folder. Covers shaft packings, valve stem packings, rod and plunger packings, piston packing, gasketing, also Teflon packings. Flexrock Co.

154 Guide to Firebrick — Bulletin 551, 8 pp, describes company's complete line of firebrick, high alumina and special Corindon brick for applications in boilers, incinerators, iron and steel furnaces, cement and lime plants, glass furnaces, pulp and paper plants, ceramic furnaces and others. Technical data, pyrometric cone equivalents, fusion points, hot load strengths, linear change, panel spalling loss, porosity and average chemical composition of various brick types are included. J. H. France Refractories Co.

155 Glass-Protected Stacks — Several installations of Permaglas smokestacks are featured in 8-pp Bulletin SS-202. They show these stacks in use in breweries, smelters, manufacturing plants. How these stacks are protected inside and outside against corrosion is told in detail, and their long-run economy is stressed. Process Equipment Div., A. O. Smith Corp.

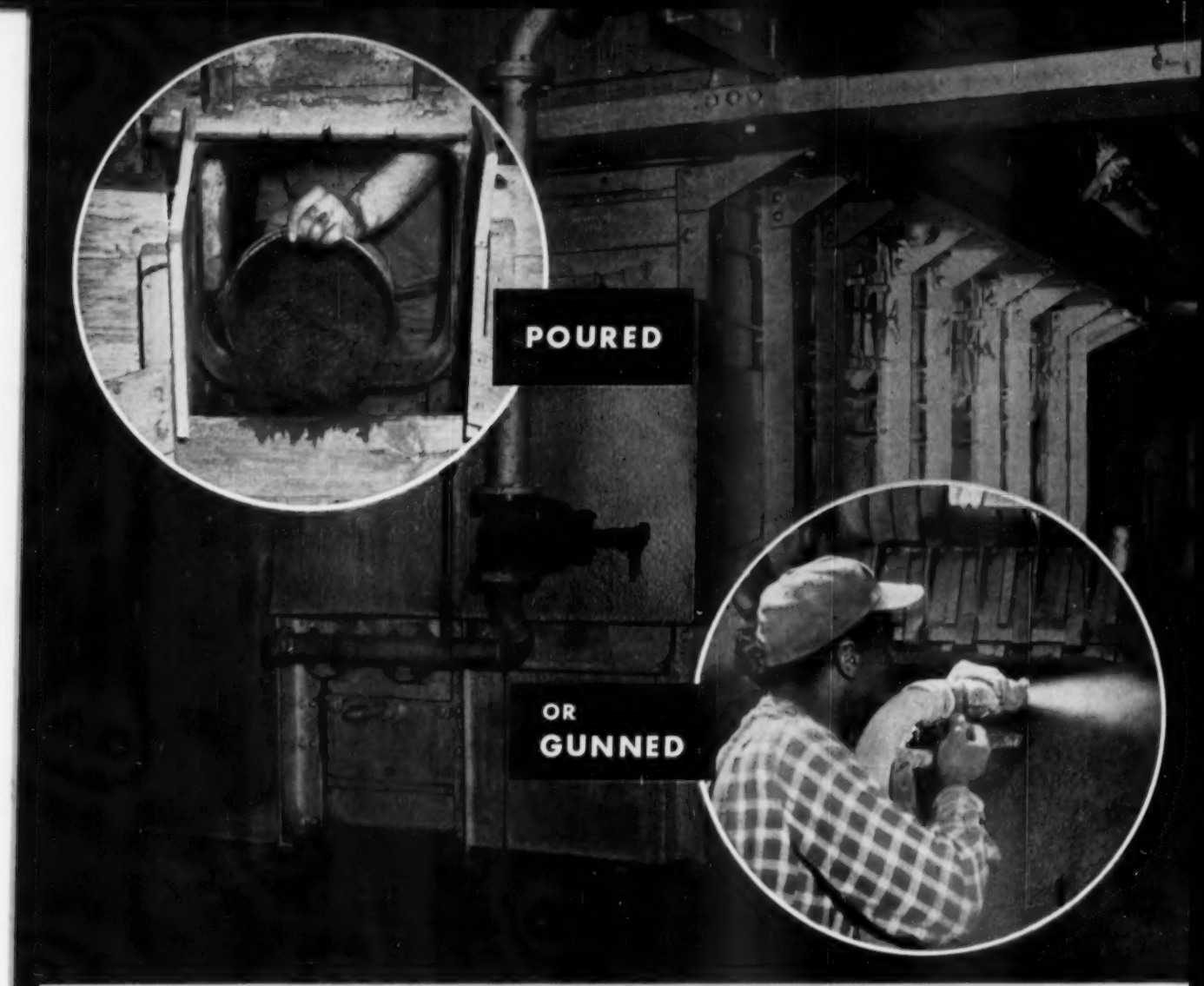
156 Pressure Filters — Publication 6322 gives details on large volume, horizontal, pressure filters for use in industrial plants, institutions, others. Describes operation, control, filter bed materials, design features, available accessories. Also shown are drawings of various arrangements of two-, three-, and four-header units. Cochrane Corp.

157 Spray Type Desuperheater — Product Specification M55-1 describes design, installation, and typical application of high capacity, fast-acting spray type steam desuperheaters. Dimensions are provided, together with helpful ordering information. Bailey Meter Co.

158 Laboratory Coal Crushers — Better testing and small scale reduction with laboratory crushers for coal sampling is the subject of illustrated bulletin 157. Crushers described have capacities from 600 to 2,000 lb per hr, depending on model, coal, and degree of fineness required. Several types of sampling discharge hoppers and riffle splitters are illustrated. American Pulverizer Co.

159 Improved Flat Belt — The Tanastic, a new concept in belt drives, is described in this 8-pp brochure. Tells how this reinforced flat belt combines the grip of leather with the strength of plastic. Provides design and application information on the belt, and includes selection data. J. E. Rhoads & Sons.

160 Weather Engineering — The role of modern weather sciences in solving industrial problems of production, marketing and distribution as well as plant location and design is told in a 20-pp brochure, "Weather Engineering for Profit". Documented by actual case histories of weather service to many industries, it discusses growth of industrial weather services and type of engineering studies, interpretive forecasting and weather modification service offered. Weather Corp. of America.



B&W Kaocrete Refractory Castables withstand punishing ashpit service

Continuous or intermittent sprays, high velocity water jets for ash removal, rakes and shovels — all these are responsible for the heavy abrasive and erosive attack on ashpit linings. But you can cut the frequency of maintenance and expensive relining jobs by using heavy-duty refractory castables which can be poured or gunned in place.

Specially designed for ashpit service, B&W Kaocrete D has the strength and hardness needed to stand up under these severe conditions. It has unusually high resistance to abrasion, erosion and spalling. Widely used in all types of boiler ashpit hoppers and slag tanks, Kaocrete D has proved its economy and durability. Where abrasive and erosive conditions are less severe, B&W Kaocrete A will give satisfactory service.

Your local B&W Refractories Engineer will be glad to give you complete details on the performance of these B&W Refractory Castables.

Send for Bulletin R-40 which gives data on B&W Kaocrete Refractory Castables for lining ashpits.

B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide

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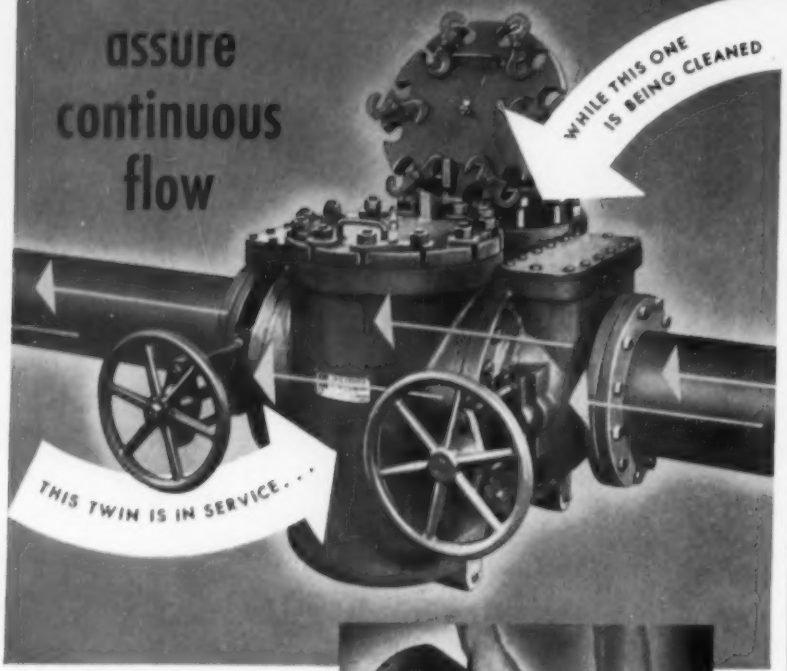
THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

R540

ELLIOTT
Twin Strainers
assure continuous flow



—provide "trouble-free" clean liquids

That's why Elliott Twin Strainers are so widely used by power plants and industry. They protect expensive liquid-handling equipment by straining liquids—without interrupting the flow. Shifting the flow from one strainer basket to another is accomplished easily by turning two valve wheels. Removing and dumping the strainer basket is simple. The result: the chance of objectionable solids gumming-up the works is eliminated.

The Elliott line of strainers also includes Single, and Self-Cleaning Strainers in sizes ranging from 1" to 24", and with straining perforations from 3/8" down to fine wire mesh. For further details contact your local Elliott District Office or write Elliott Company, Jeannette, Pa.

A7-2

ELLIOTT Company

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

For more data circle 521 on Post Card

What They Tell Us

continued from page 6

an annual bonus plan that so far has prevented any appreciable turnover in personnel.

Steam cost of 57 cents per 1000 lb with 2½-cent gas includes depreciation, as part of the annual burden charge carried by power department cost for production of steam required by the plant process.

Total burden charge is 11 per cent, and depreciation is allocated at 4 per cent of the total dollar investment in the plant.

The $5.54 cost per lb of steam capacity includes the building. However, the building is, for the cost system of an industrial plant, classified as "housing" and consists mainly of a structural steel frame, with masonry wainscoting approximately 4½ ft up, and with a rubberized corrugated siding for the balance of the height of the walls to the roof line. This plant has an interior insulation board attached to the siding above the brickwork.

If you are making an analysis of your utility costs for the hospital, I would suggest that in order to establish a basis for your cost structure, you must prepare an appraisal of the investment that exists for the production of the various services supplied to the hospital.

This total amount will then be the sum to be used for your annual burden charge make-up. It is standard practice to take 11 per cent of this amount for your first item of the annual operating costs. The result will represent your taxes, insurance, interest, and depreciation, as a part of your operating costs on an annual basis.

The total of the remaining cost items, fuel, labor, and electric power required to produce steam, water, treatment of water, sundry supplies, all on an annual basis, should be added to the burden charge. Then the total amount of your maintenance cost for a year should be added to this sum.

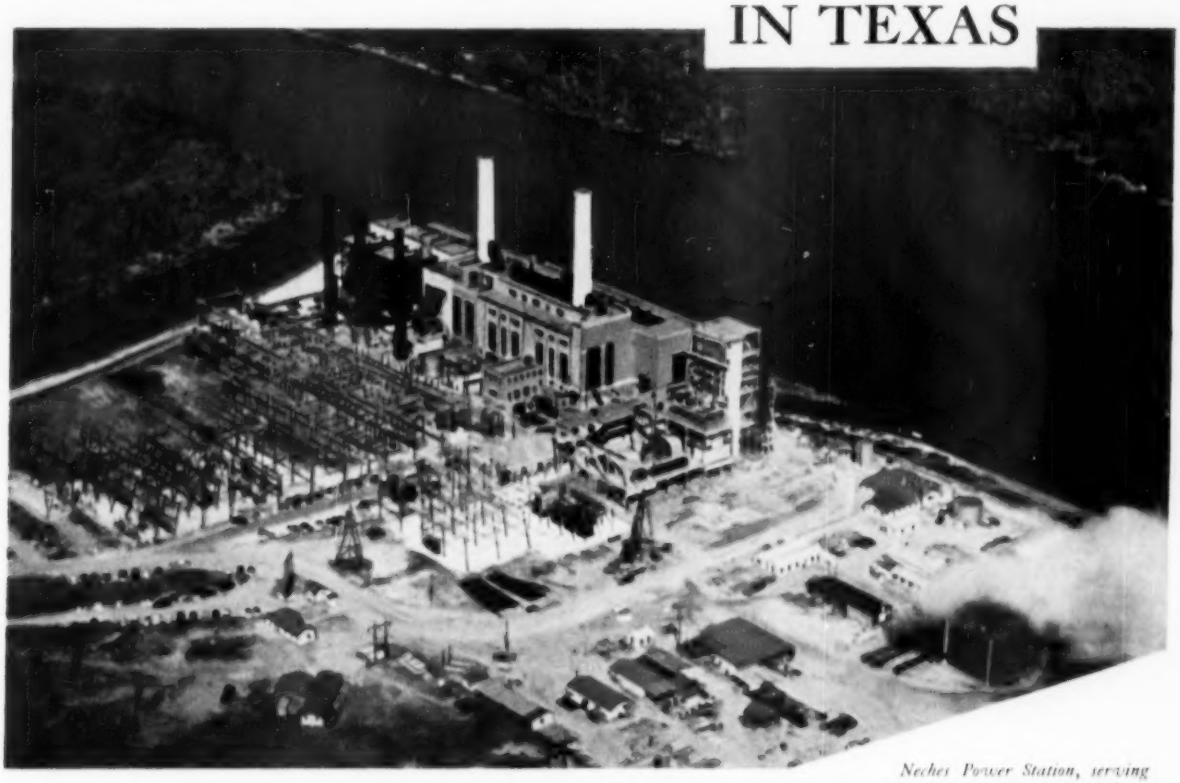
Total steam in pounds produced during the year's operation should be tabulated and divided by the total operating cost, to arrive at your cost of steam per 1000 lb.

Editor's Note: Remember that it isn't always possible to give all the information available, for a reader's company policy may restrict it. We have much other correspondence on this article that we cannot publish.

WOULD YOU LIKE TEAR SHEETS?

Readers wanting tear sheets of any article appearing in the issue for their personal file may obtain them by indicating the item desired on one of the post cards appearing in this issue—Editors.

Up-and Up-and Up-Go POWER DEMANDS IN TEXAS



Neches Power Station, serving a fast-growing industrial region, is situated on the south bank of the Neches River, near Beaumont, Texas.

During 1956 the installation of an outdoor unit comprising a turbine generator with a capability of 111,000 kilowatts, a 700,000 pounds per hour boiler and associated water cooling tower was completed at the Neches Power Station of Gulf States Utilities Company. A second such unit is due for completion in 1958.

These are the seventh and eighth units at the Neches Station which first went into operation in 1926 with a single 20,000 kilowatt generator and two 1,530 horsepower boilers. The present capability of the station is 376,000 kilowatts and 3,000,000 pounds of steam per hour.

The initial installation and all subsequent additions were designed and built by Stone & Webster Engineering Corporation.

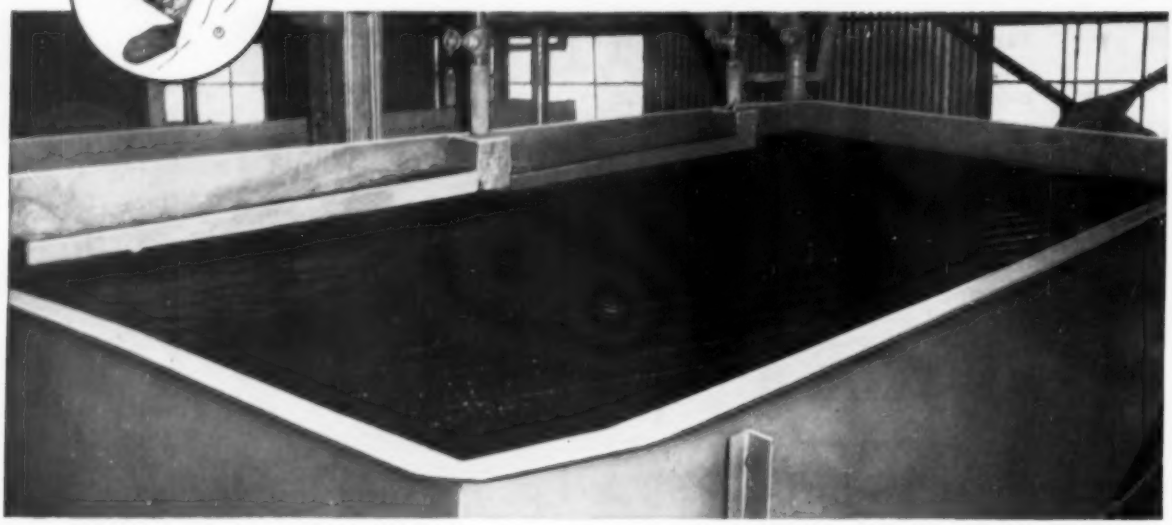
Write or call us for information as to how our experience may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

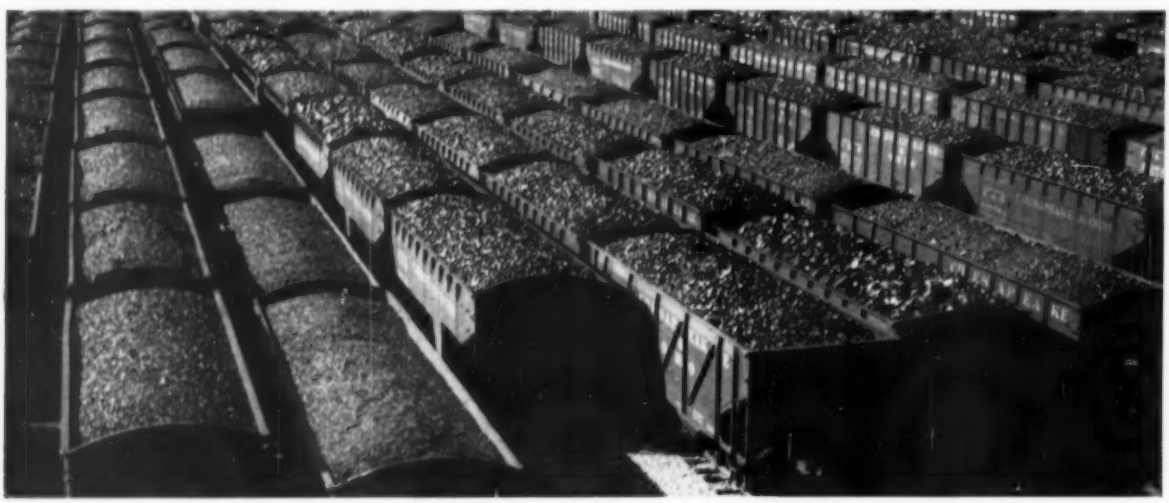
A SUBSIDIARY of STONE & WEBSTER, INC.

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Seattle Toronto

WHY CHESSIE'S RAILWAY IS FIRST IN COAL



SUPERIOR COAL. This Deister Table for washing slack is an example of the up-to-date methods employed by producers on the C & O to give you the highest quality and performance in the type of coal best suited to your needs. Superior coal means lower ultimate cost.

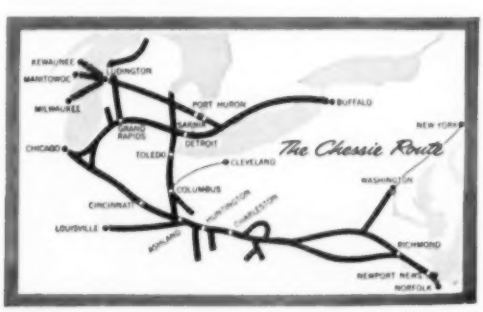


SUPERIOR SERVICE. Chesapeake and Ohio operates the world's largest fleet of coal cars with ample power to move them. By its prompt repair program C&O keeps more than 99% of these cars in good order. And C&O's new car reporting system can give you the exact location of any car on C & O lines at any time.

For dependable deliveries of top quality coals, contact coal producers on the C & O. And if you need help in meeting your own particular fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake and Ohio Railway Co., Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL



For more data circle 523 on Post Card

POSITIVE PROTECTION
AT ANY PRESSURE...
specify Consolidated

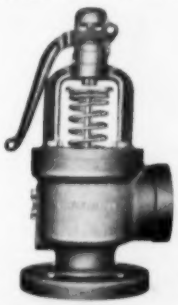
Get protection you can be sure of — whatever your working pressure. Specify Consolidated Safety Valves. Thousands of installations, in both large and small steam generating plants, attest to their complete reliability under all types of service conditions.

Many Consolidated Valves, with bronze body, are widely used for steam, air and water service; many more are installed in power plants as auxiliaries to Consolidated Steel Safety Valves. The cast iron and steel types are proving their dependability daily on low pressure boilers and those operated at super-critical pressures. The five different Consolidated Valves pictured here are representative types but the line is so complete, proper selection is no problem.

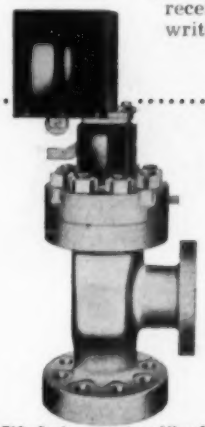
Consolidated Safety Valves are ruggedly built for long service life. Each type incorporates the fewest possible working parts for greatest efficiency. Precision craftsmanship assures positive, tight closing after operation. Through skillful engineering, valve adjustment and maintenance are made simple and easy. All these essentials contribute to outstanding performance, safety and economy.

Just send us details of your particular service requirements and you will receive correct valve recommendations. Or write for Catalog 700A.

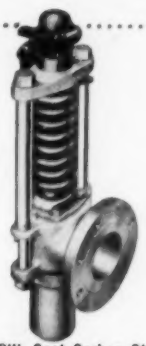
TYPE 1551. Cast Bronze Body. For package-type and fire tube boilers, air tanks and other classes of unfired pressure vessels. **Sizes:** ¾" through 3". **Pressures:** up to 300 psi. **Temperatures:** up to 450° F.



TYPE 1511. Cast Iron Body. An all-purpose safety valve for steam generator service. Cuts cost per pound of steam discharged. **Sizes:** 1½" through 6". **Pressures:** up to 250 psi. **Temperatures:** up to 450° F.



ELECTROMATIC. Carbon Steel or Alloy Steel. An electrically actuated relief valve for boiler service. Operable automatically, manually or cut out of service by setting remote control switch. Supplements spring-loaded safety valves — conserves power and increases efficiency of steam generating plants. **Sizes:** 2½" through 14". **Pressures:** up to 2500 psi. **Temperatures:** up to 1100° F.



MAXIFLOW. Cast Carbon Steel or Cast Alloy Steel. A safety valve with the greater discharge capacity and shorter blowdown demanded by high pressure, high temperature steam generators. **Sizes:** 1½" through 4". **Pressures:** up to 2500 psi. **Temperatures:** up to 1050° F.

TYPE 1415. Cast Steel Body. For water tube boilers, mechanically fired fire tube boilers, accumulators, unfired pressure vessels and pipelines. **Sizes:** ½" through 6". **Pressures:** up to 900 psi. **Temperatures:** up to 900° F.

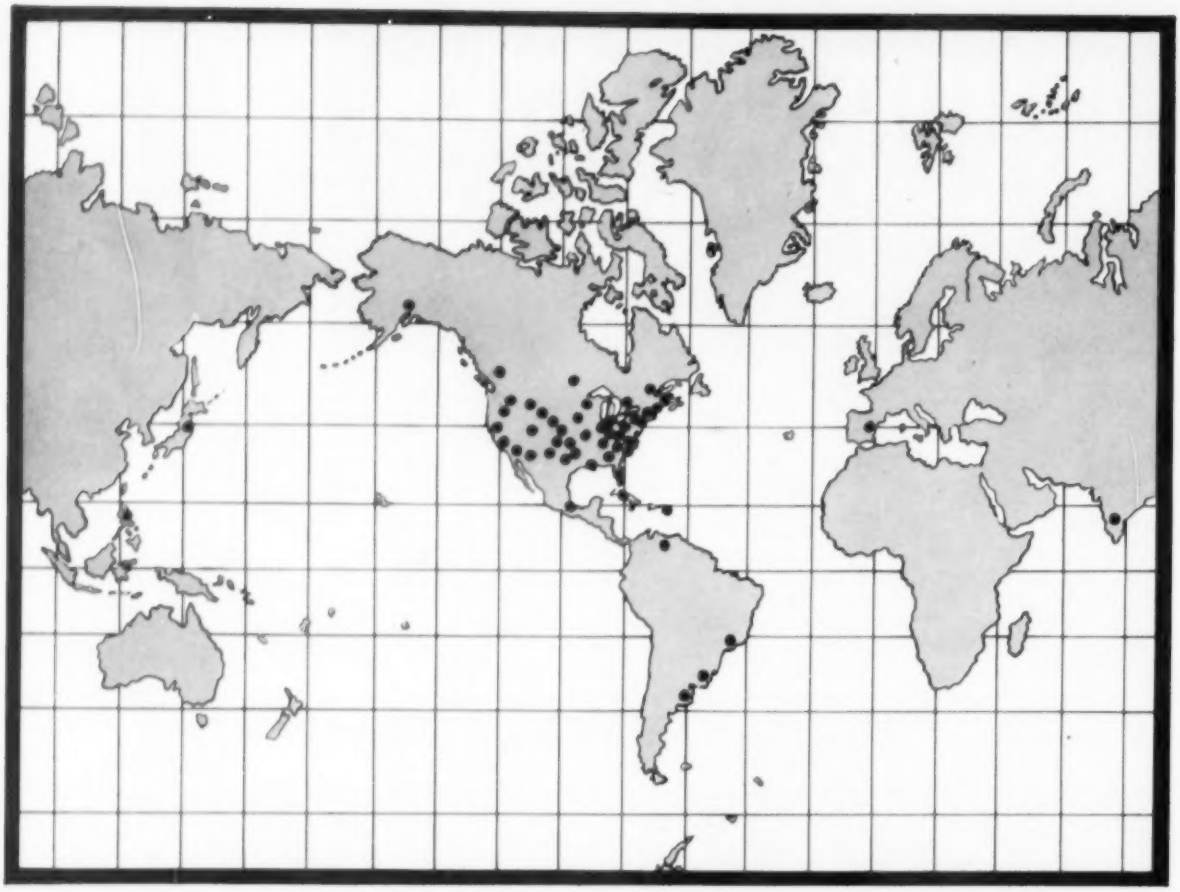
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario.

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, CONSOLIDATED SAFETY VALVES, 'AMERICAN MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Waterbury, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

For more data circle 524 on Post Card



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Service for Prefabricated Piping Systems

Over 75 field offices, both national and international are at your disposal on any project dealing with prefabricated piping systems. These field representatives offer on the spot assistance in planning, delivering and installing underground or overhead piping. A Ric-wil representative will be glad to discuss plans involving steam, hot water or oil distribution lines . . . and he represents the world's largest supplier of prefabricated piping systems.

For the name of your nearest representative or the catalog covering the Ric-wil line, call or write the home office.

Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

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RIC-WIL INCORPORATED — PREFABRICATED INSULATED PIPING SYSTEMS

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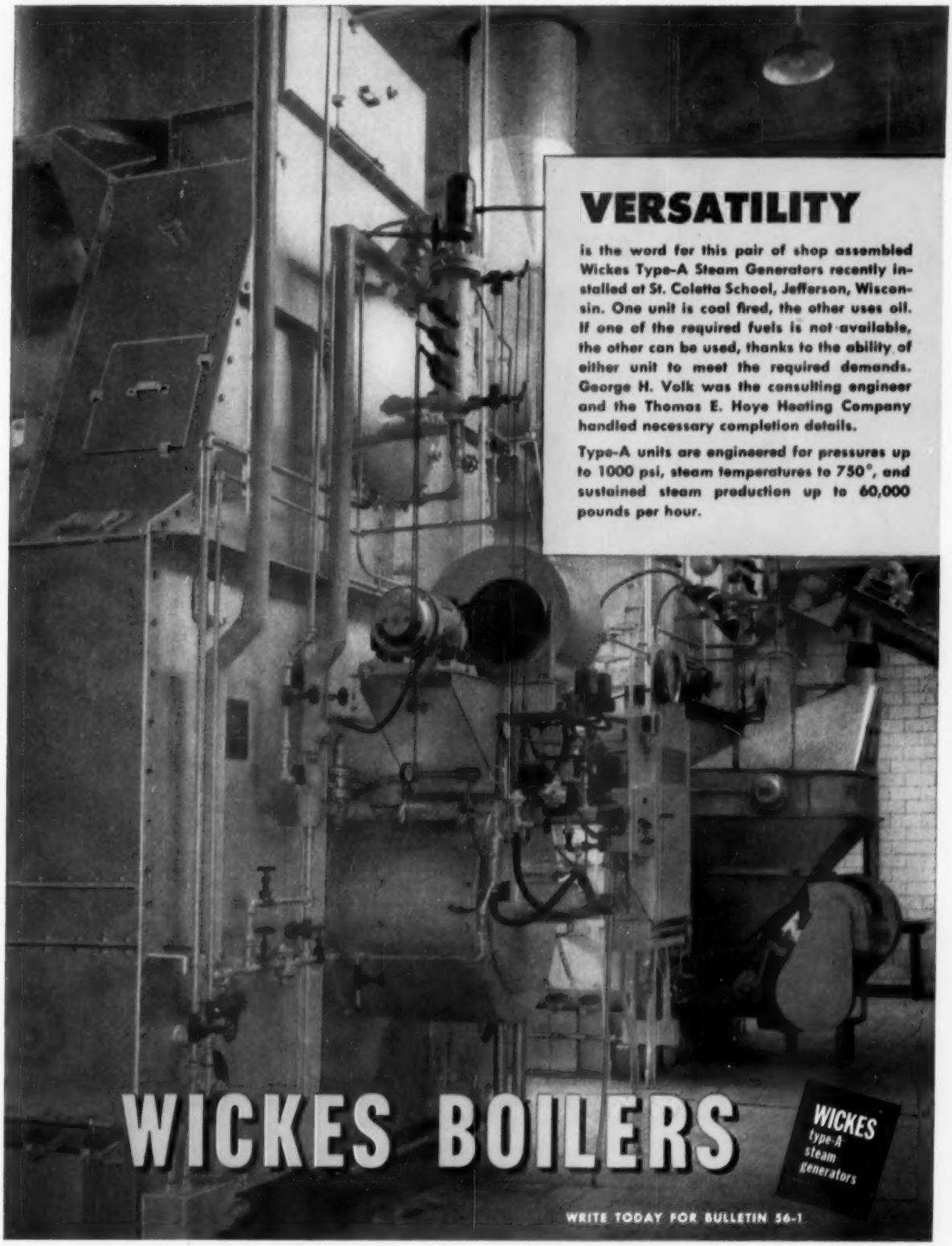
VERSATILITY
is the word for this pair of shop assembled Wickes Type-A Steam Generators recently installed at St. Coletta School, Jefferson, Wisconsin. One unit is coal fired, the other uses oil. If one of the required fuels is not available, the other can be used, thanks to the ability of either unit to meet the required demands. George H. Volk was the consulting engineer and the Thomas E. Hoye Heating Company handled necessary completion details.
Type-A units are engineered for pressures up to 1000 psi, steam temperatures to 750°, and sustained steam production up to 60,000 pounds per hour.
WICKES BOILERS
WICKES type-A steam generators
WRITE TODAY FOR BULLETIN 56-1

THE WICKES BOILER CO., DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • *SALES OFFICES:* Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Portland, Ore. • Saginaw Salt Lake City • San Francisco • Springfield, Ill. • Tulsa • Washington, D. C. 165

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How perfectly simple —this Fast's Coupling with purely mechanical flexibility!

1. A hub is keyed on each shaft. Hubs are splined at maximum distance from shaft ends.

2. Floating sleeves surround hubs. Sleeves are splined to engage hub splines.

3. Sleeves compensate for shaft misalignment by assuming neutral position between two hubs.

4. Because of distance from shaft end, any misalignment between splines is mere fraction of same misalignment between shafts.

5. Sleeves carried on bearing rings, located on *transverse center line of hub spline faces* (the load-carrying surfaces) . . . no crank action, no vibration.

6. Lubricant is centrifugally forced into spaces between engaged splines, forming a film.

For 35 years the most positive, dependable means of coupling machines to their power source . . . Fast's Couplings have no parts subject to repeated bending, tension or compression. Because there is no metal-to-metal contact, *there is no wear*—in fact, many Fast's Couplings in use for over 30 years show no signs of wear when disassembled! No leather, plastic or rubber oil seals. Lubricant film distributes pressure over a considerable area, diminishing localized stress at pressure points on the load-carrying teeth. Perfectly simple? Yes . . . and foolproof!

For coupling catalog, technical advice or assistance from Koppers field engineers, write: KOPPERS COMPANY, INC., *Fast's Coupling Dept.,* 3704 Scott Street, Baltimore 3, Maryland.

THE ORIGINAL **FAST'S Couplings**

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METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE 3, MD.
This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Industrial Gas Cleaning Apparatus, Aeromaster Fans.
Engineered Products Sold with Service.

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INDUSTRIAL WATER SOFTENERS

FAMOUS-BARR BUILDING A in Northland Shopping Center, at Jennings, near St. Louis, Mo.
Consulting Engineers: Ferris & Hamig, St. Louis, Mo.
Architect: Russell, Mullgardt, Schwarz & Van Hoefen, St. Louis, Mo.
Consultants: Marx, Flint & Schonne, Chicago, Ill.
Plumbing Contractor: Thomas J. Sheehan Co., St. Louis, Mo.

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Engineer: J. M. Rotz Engineering Co., Indianapolis, Ind.
Architect: Daggett, Naegele, Daggett, Inc., Indianapolis, Ind.
Plumbing Jobber: Crane Co., Indianapolis, Ind.
Plumbing Contractor: Freyn Bros., Indianapolis, Ind.

PANTEX ORDNANCE PLANT, St. Francis, Tex.
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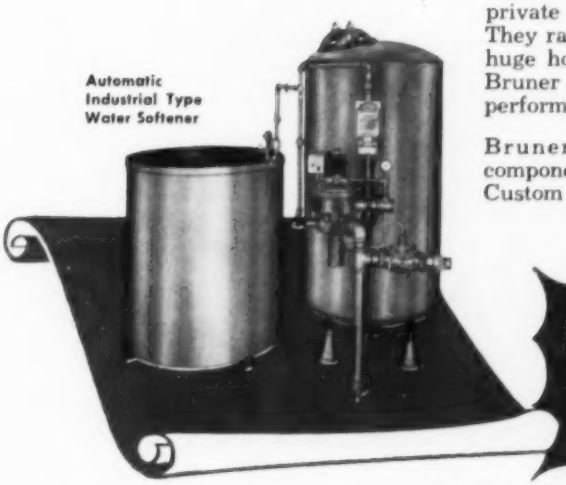
Bruner Industrial Water Softeners are meeting the needs of these important installations and in many other public and private buildings in all 48 states and seven foreign countries. They range from small laundries, schools, motels and resorts to huge hospitals, hotels, factories and atomic energy plants. Bruner is proud of its customer service — famous for product performance.

Bruner softeners, filters and other water conditioning components are available from stock in many types and sizes. Custom installations are fabricated to exact specifications.

Automatic
Industrial Type
Water Softener



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Today's

C-E STANDARD BOILERS

bring new standards of economy and reliability

If you need steam from 4,000 to 120,000 pounds per hour—or high-temperature water for heating or process applications—one of these versatile C-E Boilers will give you economical, standout performance.

Collectively, they offer you an exceptional diversity of choice. A brief consideration of the features of each will help you "pin-point" the design characteristics best suited to your situation. And remember: While they are standard in design *(which means lower first cost and proven performance)*, they are still *flexible* enough to be easily adapted to your exact requirements.

Of course, Combustion Boilers are available in other 2-drum designs . . . for capacities up to 350,000 lb of steam per hr . . . for pressures to 1375 psig . . . for temperatures to 960 F. . . . for any fuel or method of firing.

Please feel free to call upon us for further detailed information. Catalogs of each of the units shown here are available upon request.

C-E

B-8628

COMBUSTION ENGINEERING

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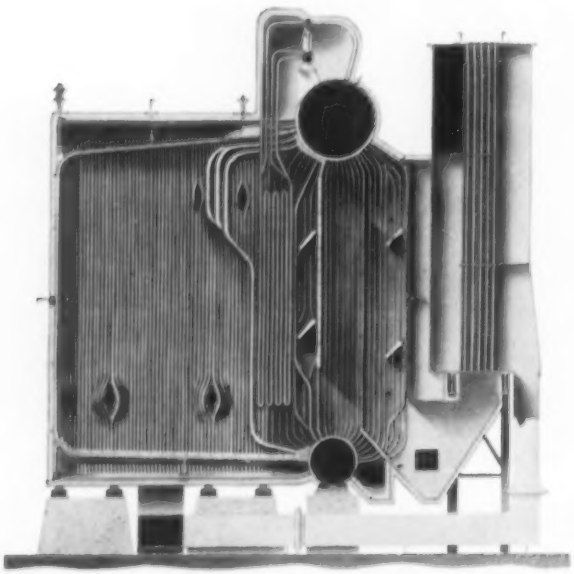
Canada—Combustion Engineering-Superheater, Ltd., Montreal

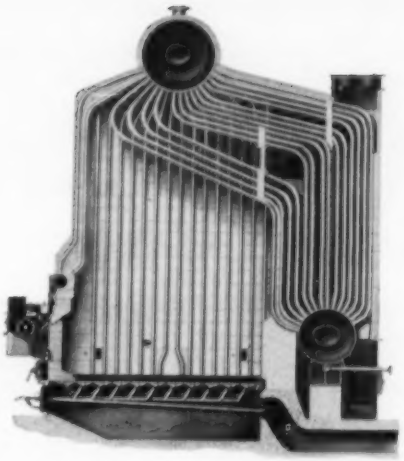
STEAM GENERATING UNITS; NUCLEAR REACTORS; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE



C-E Vertical-Unit Boiler, Type VU-55

Capacity—from 50,000 to 120,000 lb of steam per hr.

The VU-55 Boiler is available in five sizes and is designed for three pressure ranges—250, 500 and 750 psig. These units can be equipped with a superheater to provide temperatures up to 750 F. Either a tubular or a regenerative air heater is available. VU-55 Boilers are designed for the pressure firing of oil or gaseous fuel and require no induced draft fan. They are equipped with tangential burners and tangent tube furnace walls to assure a level of performance which compares favorably with modern utility practice. The VU-55 Boiler is bottom supported, requiring no supporting steel structure. The absence of exterior ductwork permits a smooth, streamlined exterior which is both attractive and practical.



C-E Vertical-Unit Boiler, Type VU-10

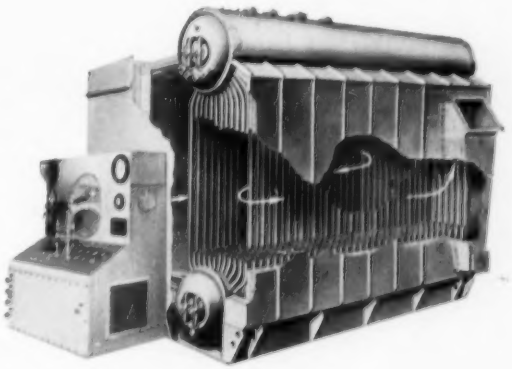
Capacity—from 10,000 to 60,000 lb of steam per hr.

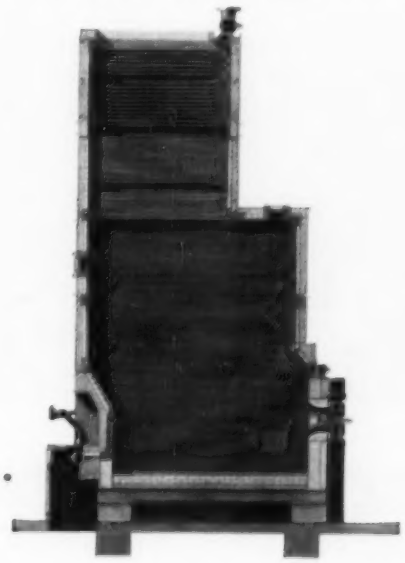
The VU-10 is available in nine sizes . . . for operating pressures up to 475 psi . . . superheat to 200 F in 20,000-60,000 lb range . . . for solid, liquid, or gaseous fuels. This boiler is a completely standardized design adaptable to many conditions. It is bottom-supported and needs no outside supporting steel. It operates efficiently over a wide range of output, and is easy to operate and to maintain. All parts are easily accessible for inspection. The VU-10 is a complete unit — boiler, furnace, setting, fuel-burning equipment, controls, forced draft, heat recovery equipment (if desired). Regardless of fuel, the same general cross-sectional arrangements of drums, convection bank and furnace wall cooling is used. Uniform design through each transverse section assures even water level in the drum and uniform expansion.

C-E Package Boiler, Type VP

Capacity—from 4,000 to 40,000 lb of steam per hr.

This completely shop-assembled boiler is available in fourteen sizes . . . for operating pressures up to 500 psi . . . for pressure firing of liquid or gaseous fuels. The VP Boiler has more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. The large lower drum — 30-inch diameter — permits a simple, symmetrical tube arrangement . . . greater water storage capacity . . . easy access for washing down or inspection. A low speed centrifugal fan which is exceptionally quiet in operation is standard equipment. The simple baffle arrangement results in low draft loss . . . simple soot blowing . . . no dead pockets . . . high heat absorption. The VP is enclosed in a reinforced, gas-tight, welded steel casing, and shipped completely assembled with firing equipment, fittings and forced draft fan. For foundation, it needs only a simple concrete slab.





The New C-E La Mont Controlled Circulation Hot Water Boiler

Capacities up to 200,000,000 Btu per hr.

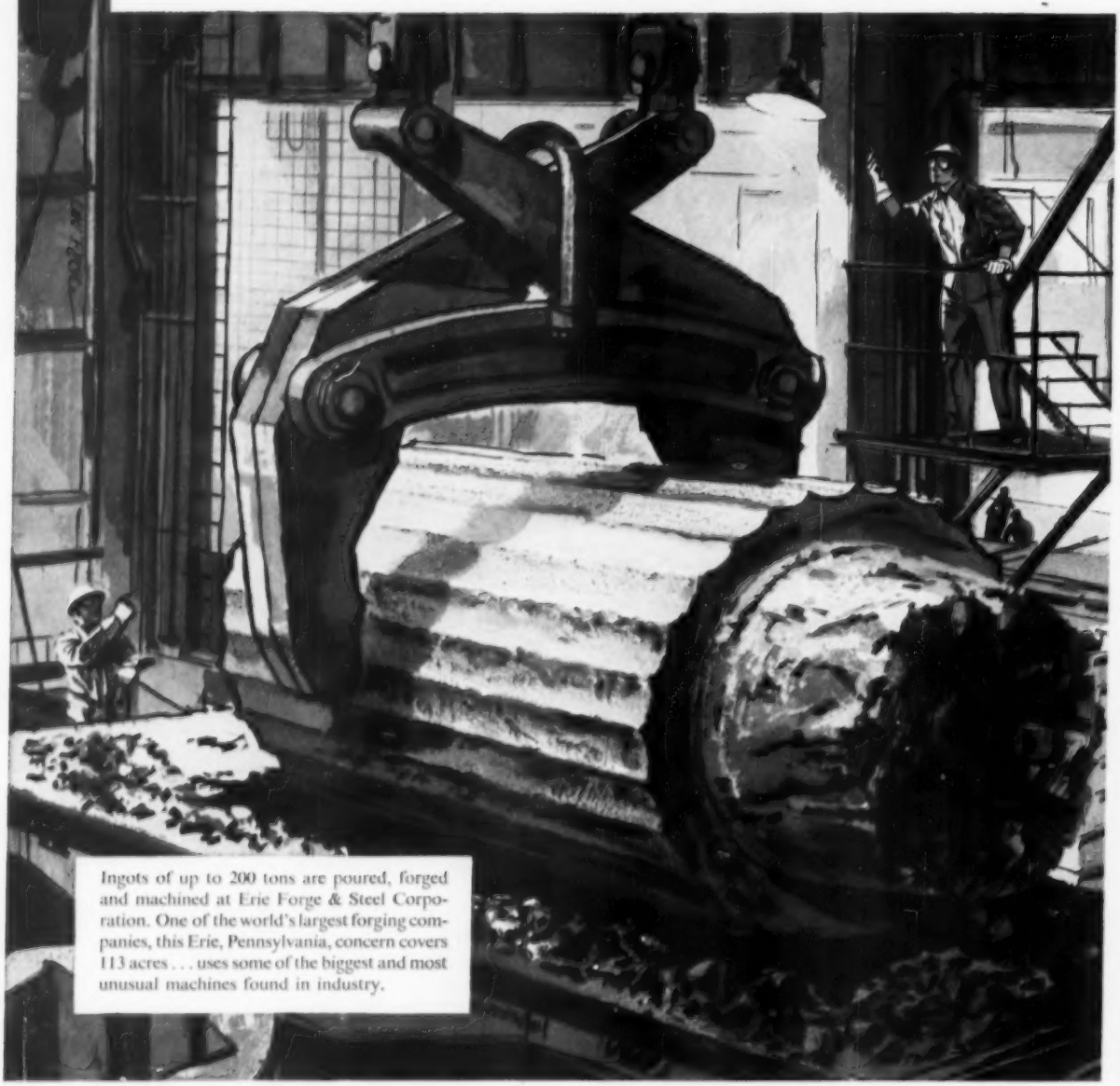
For those applications where high temperature water has inherent advantages over steam—and there are many — the C-E La Mont HT Boiler has numerous points of superiority. Among the more important of these are:

1. **Complete control** over HT water movement in both system and boiler.
2. **Low pressure** loss is inherent so no separate boiler pump is required.
3. **Pressurized operation** with oil or gas means no induced draft fan — simple stack.
4. **Single-pass design** has no baffles—low draft loss—cleaner boiler.
5. **More efficient heating surface** can be arranged because of positive, controlled circulation.
6. **Other features** such as: steel enclosed setting — few headers, all accessible—any fuel, oil, gas or coal. For pressures to 500 psig and temperatures to about 470 F.

For more data circle 529 on Post Card

Correct Lubrication in Action...

Re-Machining of Crank



Ingots of up to 200 tons are poured, forged and machined at Erie Forge & Steel Corporation. One of the world's largest forging companies, this Erie, Pennsylvania, concern covers 113 acres . . . uses some of the biggest and most unusual machines found in industry.

Mobil **SOCONY MOBIL**

Leader in Lubrication for over 91 years

in the **Forging Industry**

shaft Pins Eliminated

–$30,000 SAVED!

One of many ways Erie Forge & Steel Corporation has cut production costs over $100,000 through the help of Socony Mobil

At Erie Forge & Steel Corporation, where the world's largest crankshafts are produced, equipment and methods are constantly scrutinized for ways to increase production and reduce maintenance costs. Plant records show how Socony Mobil has helped.

For example: During machining of Diesel crankshaft pins, metal particles welded to cutting tool tip. This excessive build-up resulted in rough finish of pin surfaces. This necessitated re-machining of up to 18 crankshaft pins a day.

A Mobil lubrication engineer analyzed the operation . . . recommended a special Mobil cutting oil. Rough finish trouble disappeared, resulting in savings of $30,000 in one year. *This one saving alone more than paid for the plant's annual cost of lubricants.*

This is Correct Lubrication in Action—the *only* program that combines 91 years of lubrication knowledge with the most experienced lubrication engineers and quality products. Why not find out how it can cut your operating costs?

This complete cost-cutting service can be yours!

After a Mobil representative thoroughly analyzes your plant's lubrication needs, a program of Correct Lubrication is put into action. Here are some of the ways this program benefited the Erie Forge & Steel Corporation.

World's Greatest Lubrication Knowledge—Since 1866, Socony Mobil has worked with every type of industry, on every kind of machine operation. **This vast experience enabled Mobil to suggest a cleaning method to Erie Forge that eliminated monthly dismantling of hydraulic and circulating systems . . . saved $49,719 in four years.**

Continuous research and product development—Socony Mobil products are continually improved . . . new products developed to meet industry's latest needs. **A new Mobil extreme-pressure gear lubricant was recommended for Alliance 75-ton cranes. It cut wear under overload conditions . . . prolonged gear life . . . saved $1,500 in labor and material cost.**

Periodic product analyses—This service provides a thorough check on lubricant and machine performance . . . can detect trouble before it reaches the serious stage. **Analyses of samples taken from central coolant system at Erie Forge indicated bacterial contamination. Steps were taken to arrest condition, thus avoiding shutdown of all boring and sawing operations.**

Experienced engineers—Mobil engineers work closely with plant personnel . . . can call on years of practical experience to cut plant production costs. **At Erie Forge & Steel Corporation rams on hydraulic presses had to be repacked every two weeks due to high-temperature operation. Recommendation by Mobil engineer greatly extended packing life . . . cut labor costs . . . saved $20,000 in four months.**

Correct Lubrication

A proved program to reduce maintenance costs

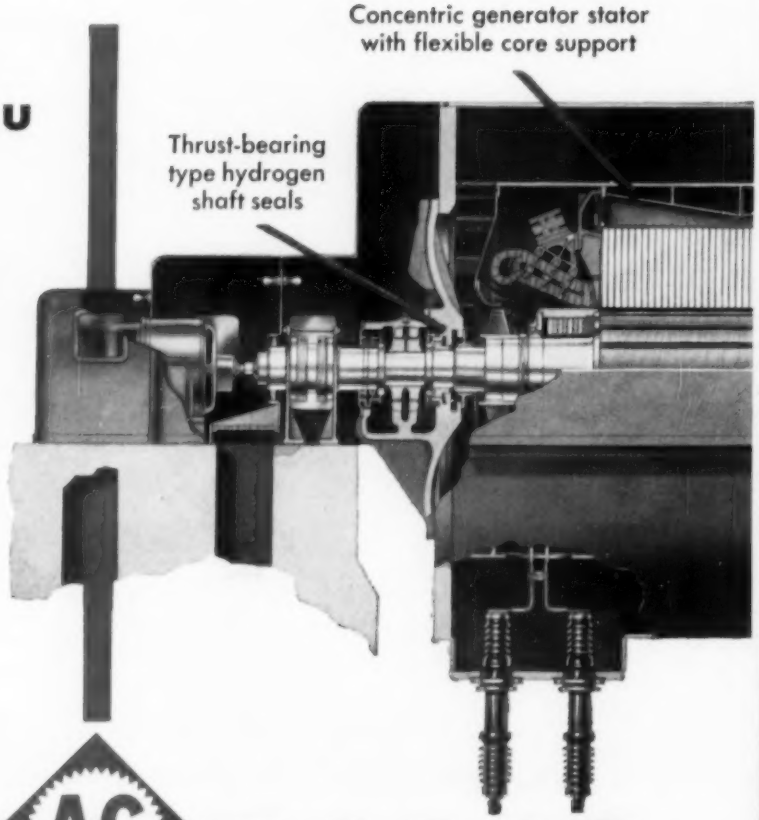
SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP., MOBIL OVERSEAS OIL CO., INC.

For more data circle 530 on Post Card

Now in Ratings

Here is the turbine rotor for one of the 16,500-kw units now being built. For this 850-psig, 900-F AIEE-ASME turbine, rotor shaft and wheels are of integrally forged construction.

Allis-Chalmers Turbines Give You MORE Modern Design Features



CUTAWAY VIEW of 16,500-kw unit shows the development of impulse turbine design for larger ratings.

A-C ALLIS CHALMERS

ALLIS-

Production up to 16,500 Kw

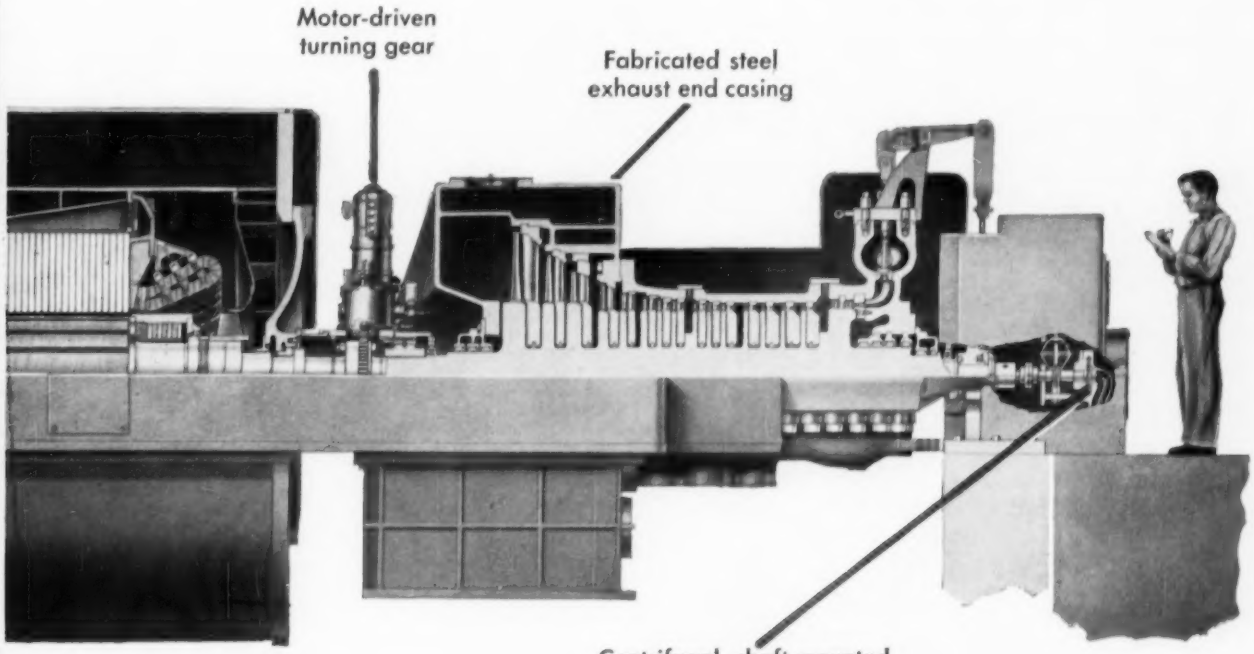
NEW Large WA-Series Turbines Offer

- **Advanced Design Features**
- **Simplified Installation**
- **AIEE-ASME and NEMA Ratings**

NEW WA-Series steam turbine-generator units now being manufactured include the 10,000-kw NEMA standard rating as well as 12,650-kw and 16,500-kw AIEE-ASME preferred standard condensing ratings. The 16,500-kw units have hydrogen-cooled generators.

Incorporated in the design are time-proved labyrinth steam sealing, removable external glands, high chrome alloy steel buckets and nozzles, reliable governing system, and unit shipment and installation — plus additional large turbine and generator features.

To get MORE information on economical, dependable units 2000 kw and larger, call the nearest A-C district office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.



CHALMERS

LIVE BETTER ELECTRICALLY

A-5127

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CONSTRUCTION NEWS

Birmingham, Ala. — Alabama Power Co, Alabama Power Co Building, has authorized a budget of $47,000,000, for expansion and improvement of company generating capacity, transmission lines, power substations, distribution lines and other operating facilities. The 1957 budget is up from $30,500,000 expended in 1956, and is the largest in the company's history. Company's expansion program since World War II has represented an investment of more than $341,000,000.

Pine Bluff, Ark. — Arkansas Power & Light Co, a subsidiary of Middle South Utilities, Inc, has announced a major expansion and improvement program for 1957, with an estimated budget of $13,770,000. This is an excess of approximately $5,000,000 over last year's budget. Company's construction program calls for the expenditure of $9,850,000 on the expansion of the electric distribution network, $2,402,000 on power transmission lines, $1,348,000 on general construction work and $170,000 on minor improvement in generating stations.

Wilmington, Del. — Delaware Power & Light Co, 600 Market St, has authorized an expenditure of $28,000,000 to be used for construction purposes of company facilities in the company's Delmarva Peninsula territory. A major item in this program is the completion of the Indian River Power Station, between Millsboro and Dagsboro, in southern Delaware which is scheduled to go into operation by November of this year. Work already under way on the second 80,000-kw Indian River generating unit installation will continue through 1957 and 1958, slated for completion about December 1958. Additional substations, transmission lines of higher voltage, distribution lines and transformers are also planned through 1957.

San Francisco, Calif. — Pacific Gas & Electric Co, 245 Market St, has authorized a major expansion budget in excess of $190,000,000, an increase over last year's expansion costs of more than $45,000,000. A considerable part of this amount will be used for extensions and improvements in plants and systems, including increased generating capacity, power substations, transmission lines and other operating facilities. Company has also announced projected plans in the future for the addition of two huge 325,000-kw steam-electric generating units to its Pittsburg Power Plant in Contra Costa County, one in 1960 and the other in 1961, each twice as large as any now in operation in company system.

St. Petersburg, Fla. — Florida Power Corp, 101 S Fifth St, has announced plans for a major expansion and improvement program of company's electric generating and distributing facilities through 1957 to cost in excess of $33,587,000. This amount is part of a $100,000,000 expansion program previously announced and now in its second year. Approximately $14,000,000 is ear-marked for the construction of a new 120,000-kw generating station to be completed in 1958 at an estimated cost of $20,000,000. Other items in the 1957 expansion budget include about $6,700,000 for transmission lines and substations, $9,300,000 for distribution lines and about $1,200,000 for auxiliary equipment.

Atlanta, Ga. — Georgia Power Co, Electric & Gas Building, a subsidiary of the Southern Company, Wilmington, Del., has announced a construction budget for 1957, of $51,000,000, — the largest in the history of the company. To finance the construction program and pay for the recent purchase of the Georgia Power & Light Co, from the Florida Power Corp, company plans financing by bond issue in the amount of $20,000,000 to be issued in mid-year. Company plans to expend about $2,400,000 for extensions and improvements of company facilities in the South Georgia area for transmission lines, power substations, and other operating facilities.

Boise, Idaho — Idaho Power Co, 1220 Idaho St, has arranged financing in the amount of $20,000,000 by bond issue, proceeds of which will be used in part for extensions and improvements in power plants and system, including transmission lines, power substations and other operating facilities.

Jackson, Mich. — Consumers Power Co, has announced a major expansion and improvement program for 1957 to cost approximately $95,000,000, a record for the company to date; $64,000,000 has been allotted for electric department projects including plans for increasing generating capacity by 18 per cent for a total of 2,033,000 kw. A new 156,250-kw steam-electric generating unit at Muskegon will be placed on line early this year and a similar installation under construction at Bay City is scheduled for operation by late 1958. Work on new Bay City Power Plant scheduled for completion by late 1959 will continue as planned. Some $20,000,000 will go toward expansion and improvement of local electric facilities in the 61 counties in the Michigan service area.

Newark, N. J. — Public Service & Electric Co, 80 Park Place, has budgeted a record expenditure of $130,000,000 on new construction for 1957. Utility plans to install 3,000 miles of wire, 6,200 distribution transformers, 8,200 street lights, 11,500 poles and 28,000 electric meters to serve this number of new power customers. Included in the budget are plans to install 280 miles of gas lines for approximately 30,000 new gas meters.

Binghamton, N. Y. — New York State Electric & Gas Corp, 62 Henry St, has announced plans for a major expansion and improvement program for 1957 of its electric and gas generating and distributing facilities. A budget to cover cost of these improvements has been authorized and company proposes to spend $32,500,000 through 1957. This is 30 per cent more than the 1956 outlay of $25,000,000. Funds will be used for expansion and improvements in plants and systems, including increased generating facilities, power substations, transmission lines, distribution lines and other facilities.

Rochester, N. Y. — Rochester Gas & Electric Corp, 89 East Ave, has announced plans for the expenditure of an estimated $20,000,000 on the expansion and improvement of its electric and gas generating and distributing facilities in 1957. New program approximates last year's expenditure of $22,500,000 on new construction for the company. Company will finance expansion with a bond issue approximating $14,000,000 to be issued in the second quarter of this year with the remainder of $6,000,000 coming from company funds.

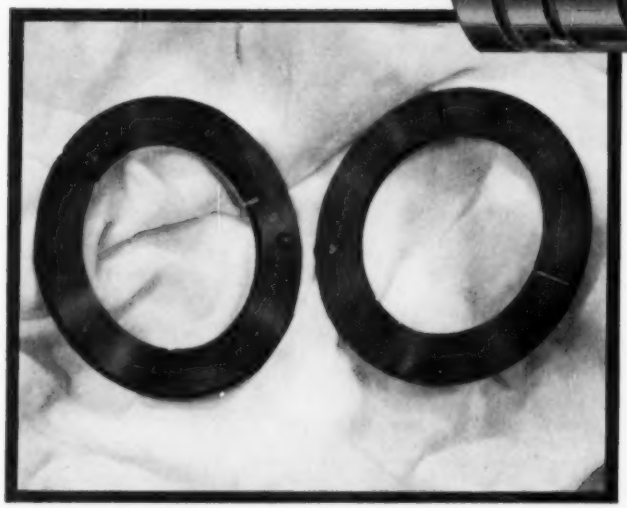
Syracuse, N. Y. — Niagara Mohawk Power Co, 300 Erie Blvd, West, has announced plans for a record expenditure of approximately $94,000,000 on new construction in 1957, an excess of $32,000,000, over last year's budget of $62,000,000. Expansion will include construction of two new 200,000-kw generators at company's Dunkirk Station; completion of the final two of five new hydro-electric plants on Raquette River in northern New York; construction of a new 17,500-kw hydro-electric plant at Prospect on West Canada Creek north of Utica, N. Y., and the beginning of operations of the first of two new 200,000-kw generating units at its Huntley Station in Buffalo, N. Y. Company will also spend several million dollars on its electric transmission and distribution system.

Akron, Ohio — Ohio Edison Co, 47 N Main St, has filed an application with the Ohio Public Utilities Commission and the Securities and Exchange Commission for permission to sell stock issue to total about $29,000,000. Company will use proceeds from the stock offering plus cash on hand and funds generated from internal operations, to help pay for its 1957 construction program totaling an estimated $55,000,000 and for additional investment in the common stock of its subsidiary, Pennsylvania Power Co, Newcastle, Pa.

Philadelphia, Pa. — Philadelphia Electric Co, 1000 Chestnut St, has announced an increase in the estimated capital expenditures for 1957 through 1961, to $460,000,000, an increase of more than $90,000,000 from the $370,000,000 previously estimated expenditure. The increased budget does not include any major expansion of company facilities not already projected. Company currently has under construction a new power station at Eddystone, Pa., which includes two 325,000-kw generators scheduled to go on line in 1959 and 1960 respectively. Another part of this expenditure will go toward installation of a 175,000-kw steam electric generator at Schuylkill Power Station, scheduled for operation in 1958.

Honolulu, T. H. — Hawaiian Electric Co, Ltd, has authorized plans for the construction of a new 100,000-kw steam-electric generating station in Waiau, Oahu, as part of a five-year program of expansion and improvement of company facilities, reported to cost in excess of $53,000,000. Program is designed to double the utility's generating capacity by 1961. The Waiau plant will duplicate installations and facilities of the Honolulu plant currently under construction. Company has been authorized by the Territorial Public Utilities Commission to offer a bond issue of $7,000,000 as a start on financing the projected expansion.

Look to COOK for Better Packings!



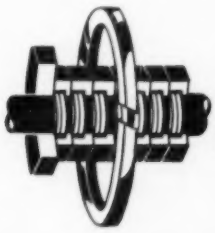
Above is a Cook design for high-pressure applications. Photo at left shows typical Cookmet bronze ring.

Cookmet Bronze Rings often worth their weight in gold!

HOW do you measure the value of packing rings that assure uninterrupted operation? Is it $5 per ring . . . $500 . . . or $5000?

For high-pressure applications, you can't afford less than Cookmet bronze packing rings. Cookmet rings are made by an exclusive formula in Cook's own foundry. They are precision-lapped to give a perfect seal when you need it most, at the start of your operation!

For recommendations about a Cookmet bronze solution to your high-pressure packing problems, write to C. Lee Cook Company, 938 South Eighth Street, Louisville, Kentucky.



C. LEE COOK COMPANY

A Subsidiary of Dover Corporation

Rings and Packings Since 1888

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EQUIPMENT NEWS

Reader Service Cards on pages 139–140 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

1—OUTDOOR MOTOR is protected against weather

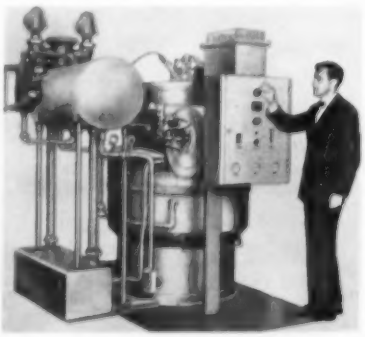
For non-hazardous outdoor installations, the Type FOD Motor is available in ratings of 250 hp and larger. It is built into a fabricated steel frame equipped with two removable air ducts. Capsule mounted sleeve bearings are supported by cast iron bearing brackets which close the end of the frame. The frame houses a removable pre-wound stator assembly unit. Stator leads, enclosed and protected, are brought to a diagonally split cast iron conduit box.

Heavy steel removable air intake ducts have openings at each end, and are designed to minimize effects of high velocity winds and entrance of entrained moisture and particles into the electrical parts of the machine. The motor's contour provides natural drainage. Gutters above air intake openings prevent water from falling into air intake stream. Immersion type space heaters for use during periods when a machine is inactive are standard equipment. Bearing temperature relays and detectors, stator temperature detectors, and stator winding thermoguards are available. Suggested applications include refining, chemical plants, power house auxiliary drives, cooling towers, general pumping. Allis-Chalmers Mfg. Co.

2—WATER TUBE BOILER is compact, fast steaming unit

The 150-hp Vapor Modulatic Water Tube Boiler is a drum type unit about one-third the size of many boilers of the same capacity. It is designed to produce low pressure steam, 5 to 15 lb pressure, for heating industrial plants and commerical buildings. According to manufacturer, it develops steam in 5 min from a cold start. Hot gases from a forced draft fire, burning oil or city gas fuel, wipe over and around the four sets of steel coils heating the water as it is pumped through the coils. Two turbine type water pumps, driven by one electric motor, re-circulate water from the steam drum through the coils. Steam rises off the water in the drum and passes through a separator inside the drum, to remove excessive moisture, before the steam is fed into the plant's heating system.

This new package boiler is 96 in. high and long, is 80 in. wide, and mounted on a steel base plate. It comes fully assembled with automatic controls, ready for service connections. (Other models



of the drum type Vapor Modulatic Boilers are designed to produce steam up to 125 lb pressure, and units capable of producing up of 5000 lb of low pressure heating steam and others up to 125 lb working steam pressure are planned.) Safety controls provided include steam temperature limit control, two safety valves, outfire control and low water shutoff. Vapor Heating Corp.

3—ADDITIVE keeps sludge out of the fuel oil tanks

Used for several years in home heating oils, Fuel Oil Additive No. 2 is now reported to prevent operational problems of industrial heating plants using heavier and cheaper residual oils. The product is a sludge dispersant — it acts to prevent sludge and gummy residue from forming in storage tanks by keeping the tiny particles in the fuel from clustering together and settling to the bottom of the tank. Because the additive keeps the particles small, it prevents clogging of filters and burner nozzles, company points out. When used in large enough quantities and recirculated through the storage tank, it cleans out accumulated sludge, manufacturer states, and continued use keeps new sludge from forming. E. I. du Pont de Nemours & Co.

4—STEAM TRAPS operate on temperature differential

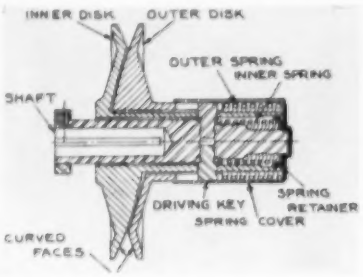
Series A Thermostatic Steam Traps operate on a temperature differential principle as contrasted to buoyancy. Of cast semi-steel construction, the traps are designed for installation requiring frequent shutdowns and start-ups, elimination of large amounts of air or maximum protection against freezeup. Traps are provided with bronze or Monel bellows and vertical outlets. The traps are fitted with an orifice that operates entire pressure range from 0 gage to maximum rated pressure. Traps are made for steam pressure up to 250 psi and temperatures up to 450 F. Inlet and outlet connections provided are $\frac{1}{2}$ in. and $\frac{3}{4}$ in. Angle or straight-through piping is optional. The Clark Mfg. Co.

5—FLOW LUBRICATOR delivers oil to high, inaccessible points

This pressure sight flow lubricator is designed to deliver lubricating oil or other liquids under pressure, in accurately measured quantities, to high or otherwise inaccessible points. It is available as a single unit or in multiples to 15 depending upon the number of feeds required. Each lubricator making up a multiple unit is capable of feeding fluid in amounts varying from several drops to two pints per minute by simple adjustment of individual needle valves. Single lubricators are available with $\frac{1}{4}$ or $\frac{3}{8}$ in. ips inlet and outlet. Inlet sizes of multiple units range to $\frac{3}{4}$ in. ips with $\frac{1}{4}$ or $\frac{3}{8}$ in. ips outlets. All are designed for 125 psi maximum working pressure. Wm. W. Nugent & Co., Inc.

6—VARIABLE SPEED PULLEYS require almost no maintenance

Models 175 and 180 are announced as low-cost variable speed pulleys with a speed ratio of $2\frac{1}{2}$ to 1 and as practically maintenance-free. Oil-impregnated



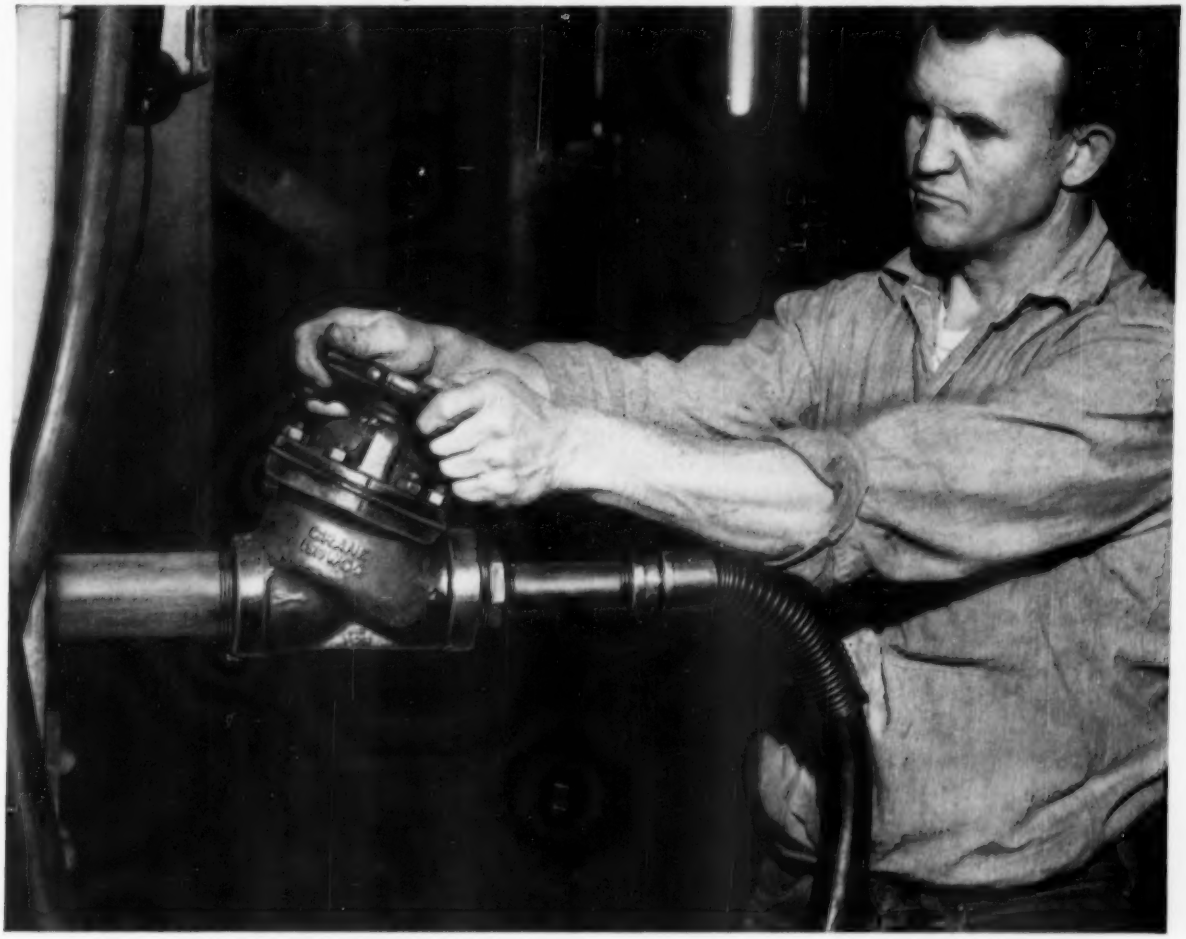
bushings eliminate lubrication. According to company, units are easily installed on old or new equipment and are especially recommended for simplified installation where speed changes are required to instantly compensate for variations in production schedules or differences in ability of operators. They use a standard B section V-belt. Model 175 is rated $\frac{2}{5}$ hp 1150 rpm and 1 hp at 1750 rpm; Model 180 is rated 1 hp at 1150 rpm and $1\frac{1}{2}$ hp at 1750 rpm. Pitch diameter is 5.93 in. and length of bore is $2\frac{3}{4}$ in. Lovejoy Flexible Coupling Co.

7—OIL BURNERS utilize improved atomizing principle

Substantial fuel savings for commercial plants are reported possible with the MicroMist Oil Burners — they are designed to operate efficiently with any grade of commercial fuel oil up to and including heavy No. 5. They incorporate an oil atomizing principle which reduces even heavy oil to a highly combustible microscopic mist. A direct electric ignition system is used in the MicroMist, no gas being required. Heart of the MicroMist is a supercharger or compressor. The oil is mechanically atomized as oil and primary air pass into the compressor. The compressor-atomizer then further reduces the oil spray, by heat of compression, to a microscopic air-oil mist.

Lower installation costs are also claimed for this burner, which is shipped as a package, complete with factory wired control system in an enclosed integral panel, ready for installation at

Recommended by Crane for hard-to-hold fluids



Utility finds these valves ideal for holding transformer oil

Note how clean the valve—not even a sign of oil seepage.

Two years ago, Southern California Edison Co. at its Alhambra shops installed this Crane diaphragm valve on oil refill lines for transformer servicing. Operated about 12 times daily, it has never shown any sign of leakage.

The Utility says they are enjoying exceptional performance with this valve. No troublesome maintenance such as refacing valve seats or repacking stuffing boxes.

Independent seating and bonnet sealing set Crane valves apart from ordinary packless or diaphragm valves. The Crane diaphragm is used only to seal the bonnet—that's why it lasts so much longer. A "soft" insert in the disc face gives tight seating on the hardest-to-hold fluids, liquid or gas.

Ask for this Circular

Moderately priced, Crane diaphragm valves are ideal for many services—common and corrosive. They're made in body materials ranging from iron to stainless alloys. Diaphragm and disc insert available in neoprene, natural rubber, buna N, Kel-F, etc.

Get full information from your Crane Representative or by writing to address below for Circular AD-1942.

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

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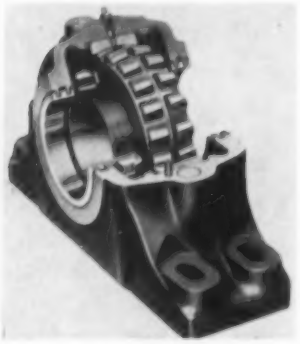
the job site. Maintenance expense is also reduced because fairly frequent cleaning of atomizing nozzles is not necessary, says company; also lubrication oil is not needed in the compressors, and all models operate with only one motor. No special boiler front, secondary air door or checkered combustion chamber floor is used. MicroMist Burners can be applied to all types of existing boilers or used as a component part of a packaged boiler-burner unit. Firing rates of burners range from 3 to 25 gph and a variety of controls is available. Iron Fireman Mfg. Co.

8—PILLOW BLOCKS utilize unique mounting feature

Spher-Align Pillow Blocks incorporate a mounting feature, called Micro-Mount, which makes it possible to seat the bearings solidly on shafts quickly and easily, it is announced. This is accomplished in the new line of spherical roller bearing pillow blocks through use of set screws located parallel to the bore in the adapter nut. After bearing is snugged



up with the adapter nut, adjustment is completed by turning the screws against the locking washer until bearing, adapter and shaft form an integral unit.

Spher-Align Pillow Blocks are suggested for applications in which self-alignment and ease of installation and maintenance are desirable. The compact housing is made of close-grained semi-steel to withstand shock loads. The units are designed to allow lubricant to enter at the center of bearing and outwardly along all bearing surfaces, and convenient drain plugs permit use of either grease or oil and provide for easy flushing. Triple seals retain the lubricant. Dimensions of Spher-Align Pillow Blocks are standardized to make them interchangeable with similar units. They come in both expansion and non-expansion types in sizes to fit shafts from $2^{7}/_{16}$ to 8 in. diam. Dodge Mfg. Corp.

9—VIBRATING FEEDER has pneumatic drive mechanism

Instead of using electric vibrators or motors, this feeder has its vibrating force generated by a pneumatic drive mechanism. The unit is completely metallic. Manufacturer says its operation is feasible under conditions of high temperature and corrosion normally damaging to many types of feeders. A wide variety of bulk materials like sand, gravel and small parts can be carried by the feeder, it is claimed, and even fine powders and cement. Some materials can be fed at an uphill slant of 20 deg. According to manufacturer there is only one moving part in the drive mechanism, and the enclosed construction seals out dirt and foreign matter. Rates of feed are adjustable. Vibration frequency is selected by varying operating air pressure over a range of 30 to 90 psi, providing control of feed rates. The Cleveland Vibrator Co.

10—MULTI-USE GREASE is lithium based lubricant

Gulfcrown Grease is designed to provide superior lubrication under conditions which often require a variety of special greases — high and low temperatures, action of water, high-speed bearing action, and long storage. Four features are claimed for this lubricant. First of these is high oxidation stability to provide longer life both in use and in storage. Other advantages cited include high mechanical stability to keep grease from thinning and running out of bearings; high resistance to washing action of water to provide continued lubrication under dampest conditions and effective protection against rust; and ready flow in cold weather. Gulfcrown Grease comes in four consistencies and can be applied by grease guns or through a centralized lubrication system. Gulf Oil Corp.

11—CIRCUIT BREAKER features increased interrupting capacity

This magne-blast power circuit breaker rated 75 mva, 1200 amp is now available with company's light duty 4.16 kv metal-clad switchgear. The higher rating allows a 50 per cent increased interrupting capacity over existing 4.16-50 mva metal-clad switchgear, while not expanding space requirements. The 75 mva breaker is suitable for use with correspondingly larger power supply transformers and unit substations. According to company, it has many of the desirable features of higher rated, heavy-duty magne-blast circuit breakers, including improved insulation levels and a positive mechanical interlock, and is no larger than the 4.16-50 mva unit. It is designed to provide full interrupting capacity in five cycles or less. General Electric Co.

12—POWER TRANSMITTER is solenoid operated

Rapid stop-start machine operation can be remotely or automatically controlled with the Type J, a solenoid operated power transmitter, it is announced. The transmitter is designed primarily for use in driving conveyors, and other machinery. Manufacturer claims that

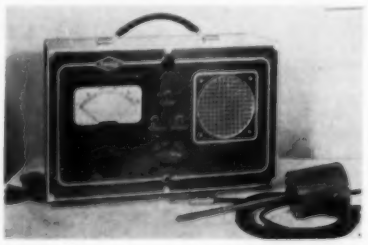
40 or more starts per minute are possible when driving machines with reasonably low inertia. The new motor uses a constantly running motor-driven flywheel with a short throw clutch, the latter actuated by two solenoids arranged in tandem and normally supplied for 115 v, 60 cycles. One engages the clutch, and the other, the brake. Control is accomplished by a stop-start push button station, or can be automatic through use of limit switches, sensing devices, timers or other controls. The Type J is a totally enclosed, fan-cooled unit with pre-lubricated ball bearings. (It is also available without solenoid control.) Diehl Mfg. Co.

13—WIDE-ROLL CUTTER makes pipe cutting easy and accurate

Easier, better pipe cutting with a power drive, is announced for the Ridgid 202 Wide-Roll Cutter for heavy duty use. Extra wide roll built into the 202 cutter features double the bearing surface on pipe. The wide roll sets and holds revolving pipe at a perfect right angle, it is noted, to assure quick, clean starts for perfect tracking and straight cuts. Changes to special rolls are not necessary, company points out. Larger screw handle facilitates cutting adjustment. An extended shank protects screw threads from damage by power drive support bar, and gives greater thread bearing surface for easy turning into the pipe cut. The Ridge Tool Co.

14—BEARING TESTER detects and measures wear

Resembling a portable radio in size and appearance, this bearing tester is designed to detect and measure wear in bearings, gears, spindles or slides without disassembly of machinery. The instrument consists of a metal probe, or



pick-up, connected by electric cord to a compact electronic amplifier with calibrated meter, loudspeaker, controls and, if desired, devices for making permanent records. Its power supply is any convenient electric outlet.

The tester operates on the principle that disturbances caused by parts malfunctioning are reflected as noise energy in the supporting bearings. The probe picks up this transient energy output, or friction loss from the relative movements of contacting parts. It senses both overall noise level and instantaneous noise changes, and these are shown on the meter. Sperry Products, Inc.

15—TRANSMITTER designed for process pressure applications

Model 44 is described as an inexpensive indicating pressure transmitter, accurate to ± ½ per cent of scale range, for pneumatic transmission of process pres-

New Revolutionary Steam Trap

One large capacity seat for all pressures!

New Sarco Thermodynamic steam trap. Sizes ⅜ to 1"...each body as small as a tee fitting! Capacity is determined, not by a bulky body, but by the effective orifice, valve action, pressure drop and condensate temperature.

1. Cuts trap inventory

With the revolutionary Sarco TD steam trap, you use exactly the same trap...with exactly the same large capacity seat...for all pressures 10-600 psi...for heavy, light or no condensate load. Sizes ⅜ to 1".

2. All pressures 10 to even 600 psi!

...without changes or adjustments. Self-adjusting. High pressure construction...at a low pressure trap price!

3. Operates perfectly when pressure fluctuates

Absolutely no effect even from 600 to 10 psi! No water seal to evaporate. No adjustments.

4. Widest capacity range

Same large capacity seat for 10 as for 600 psi. Pressures of incoming air and condensate INSTANTLY AND FULLY raises valve head (disc), permitting maximum discharge.

5. Operates equally well on all loads

The same Sarco TD trap for heavy, light or no condensate load. No prime to lose. No adjustments.

6. No oversizing worries

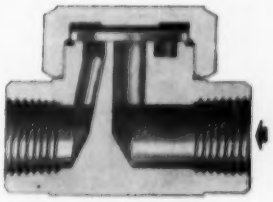
You can size the new Sarco TD steam trap for peak condensate loads...without risk of blowing steam on light loads... no prime to lose...no adjustments.

7. No steam leak required

...to operate the revolutionary Sarco TD steam trap (Pat. Pending). Closes tight against steam!

Convince yourself by 60-day trial...use coupon

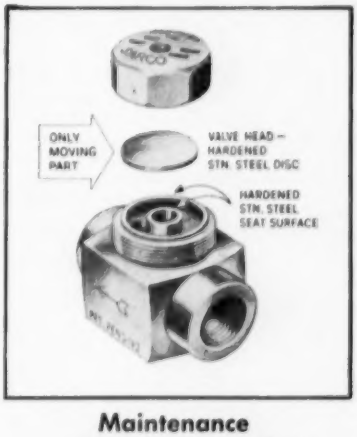
SARCO



Trouble-free design

Here is a trap so simple, it doesn't even have a valve closing mechanism. The kinetic energy of steam closes the valve. ONLY the new Sarco TD uses this operating principle.

No mechanism parts to wear or stick. No narrow channels to choke. No gaskets to leak.



Maintenance practically eliminated

The all-stainless steel Sarco TD has only 3 parts...cap, disc and body. Only moving part is a hardened SOLID stainless steel disc, practically wear-proof.

SARCO COMPANY, INC.
Empire State Bldg., N. Y. 1, N. Y.

Please send me Sarco TD Steam Trap and strainer for 60-day trial.
Size_____ For use on_____

Name_____

Firm_____

Address_____

City_____ State_____

5101-B

For more data circle 534 on Post Card

sure measurements. It measures pressures of 0-30 in. of water to 0-6,000 psi, transmitting a 3-15 psi air signal to indicating, recording or controlling instruments. To accommodate the various ranges, a choice of pressure elements is offered: spirals, helicals, bellows and diaphragms. Element materials are available for corrosive process fluids.

This transmitter has an eccentric indicating scale 4½ in. long, built into the front of the case, making a separate field gage unnecessary. Markings are declared visible 20 ft away. Universal mounting bracket permits installation on wall surface mounting or on vertical pipe. Output and 20 psi air supply connections are ¼ NPSF; measurement connection, ¼ or ½ NPT, depending on pressure range. The Model 44 is only 8⅛ in. high. The Foxboro Co.

16—OIL FILTERS of simple design, throwaway cartridge

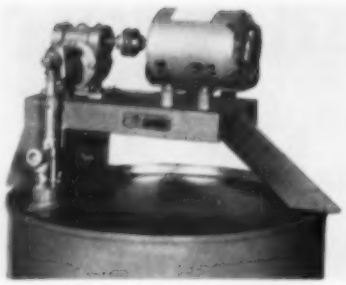
Simplified three-piece construction for easy servicing and throwaway cartridge are features of the R Series Hilco Hyflow Oil Filters. They are especially designed for filtration of lubricating and fuel oils used in internal combustion engines, for oil bath air filters and for filtration of various industrial oils, fuel oils, solvents and coolants. Bulletins F-135, F-153 and F-154 give specifications and other data. The Hilliard Corp.

17—CELL FILLER controls electrolyte level in batteries

Developed especially for railway service, Rite-Hite is now available to industrial plants. This cell filler controls electrolyte level in batteries by adding water to the correct height without overflushing. Rite-Hite comes in three horizontal and two vertical models.

The filler, connected to a water supply of 20- to 50-psi pressure, consists of a

tube and a hydrostatic means of controlling flow. With the end of the tube inserted in the cell opening to the proper depth, as determined by a stop on the tube, water flow is turned on by a lever that operates a spring valve. As soon as the electrolyte level covers the tube end, a partial vacuum within a small copper tube running inside the water tube builds up and causes a diaphragm within the housing to release the spring valve and stop the water flow. Maintenance of the Rite-Hite is declared simple — it has few moving parts. In cold areas, it should be drained of water when not in use to avoid freezing. Gould-National Batteries, Inc.



18—BLENDING METHOD for mixing bulk materials

This system of blending bulk materials to produce a uniformly homogeneous mixture in a continuous flow is expected to be especially useful in such applications blending coking coal for steel blast furnaces. Blending is done in a metal or concrete bin (any size, depending on requirements), containing a series of overlapping baffles which deflect out-flow to the sides of the container. Material to be blended is layered into the bin by a belt conveyor tripper on top of a rectangular bin, or a chute in the case of a cylindrical bin. While the bin is being emptied from the bottom the incoming material is directed into the side chute section in a continuous series of small increments from top to bottom. Blending thus takes place automatically as small portions of each layer enter the chute area and flow downward by gravity. At the bin bottom, material is removed from the outlet shelf by a plow or other device and taken away by a belt conveyor. Hewitt-Robins Inc.

19—MULTIPLE INDICATOR for remote reading of variables

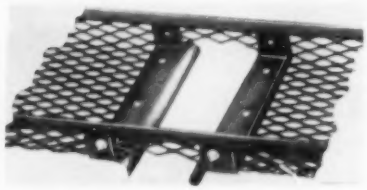
This drum-type precision indicator for quick readings of variables at remote points uses company's standard Dynamaster electronic instrument components. It has numbered push button switches on the front of the case, and can scan up to 48 remote points quickly. The revolving drum-type scale has a calibrated length of over 26 in. Full-scale travel takes place in 4½ sec. Offered primarily in resistance thermometer and pyrometer models, it can also be supplied for measuring other variables. Bulletin P1245A gives more details. The Bristol Co.

20—CONTROL SWITCH for use in hazardous locations

An explosion-proof electrical switch which can be used as a free cable "on and off" control switch in hazardous spots is announced for use with company's electrically rewound hose reels for in-plant liquid or gas delivery or fire protection. The switch is claimed waterproof and weathertight. Sealed into it is a 5-ft length of Type SO cable with two No. 18 conductors and one No. 18 ground wire. Compact and lightweight, it is supplied with terminals and fitting, and two types of mounting brackets are available. Manufacturer says it is UL approved for Class I, Groups C and D, for d-c pilot duty 24 v maximum. It can be mounted on a hose reel, or used as a free-cable switch. Clifford B. Hannay & Son, Inc.

21—BARREL PUMP meters toxic and corrosive chemicals

This controlled volume pump for barrel head mounting meters toxic and corrosive chemicals from up-right, 55-gal barrels against pressures to 100 psi. Available in maximum capacities from 500 milliliters per hour up to 4 gph, the portable barrel pump has constant speed, ⅓ hp, 115-v, 60-cycle motors. Capacities are adjustable from zero to maximum. The repetitive pumping accuracy of these barrel pumps is given as ± 1 per cent. Milton Roy Co.



22—DROP OUT FITTING for use in cable trough system

Designed for use in this company's cable trough system, this new fitting lets cables be dropped out at any point in the run to connect with motors etc. There is no need to specify the exact location of the drop out, it is pointed out, because a hole can be cut in any section of the trough at any time before, during or after installation. The trough itself is expanded steel mesh. Holes are cut in the mesh with an air saw or hack saw. T. J. Cope, Inc.

23—REGULATORS have increased short circuit strengths

Three-phase step voltage regulators in this company's MLT-32 line now have short circuit strengths of 25 times normal when operated at advanced current settings. Those rated up to 750 kva will carry currents as high as 130 per cent of rating when the regulating range is trimmed to ± 5 per cent at the "load bonus" position indicator. Now, according to manufacturer, these regulators will withstand short circuit currents 25 times normal at any range setting long enough for circuit interrupting device to act. For example, it is noted that a regulator with a basic rating of 100 amp at ± 10 per cent regulation, when set at ± 5 per cent can carry 130 amp. Short circuit strength at this range is 25 times 130 or 3250 amp, for 1.2 sec. General Electric Co.

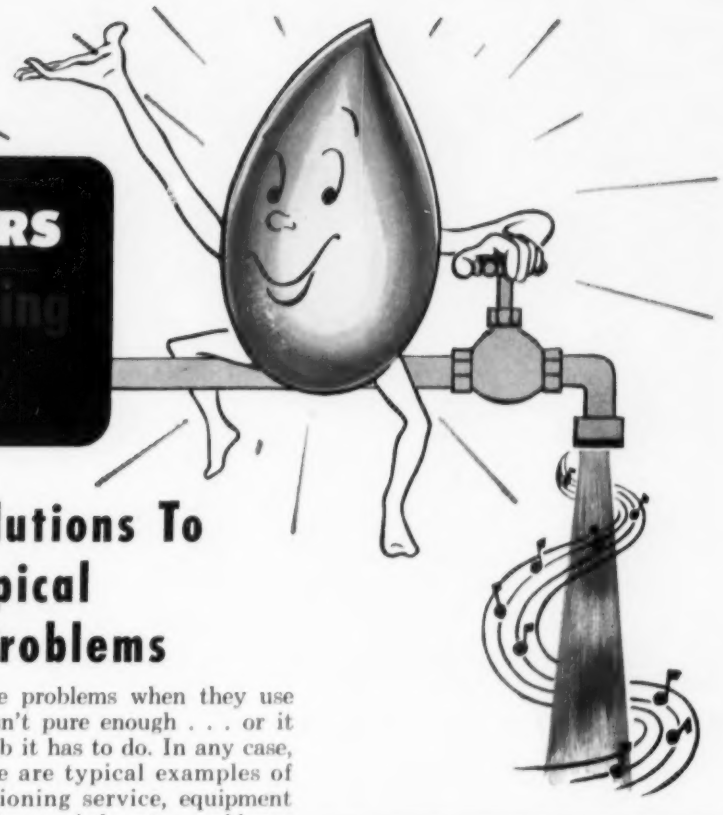
24—AFTER COOLER removes moisture from compressed air

Announced as a more economical design Aero After Cooler, this large capacity unit offers a self-contained method of cooling and removing moisture from compressed air, independent of a large supply of cooling water and replacing both shell and tube cooler and cooling tower. It also combines in one machine provision for cooling compressed air and also for cooling water in a closed system for intercooler and compressor jackets. The apparatus consists of two parallel mounted cooling coils (one for jacket water and one for compressed air) in separate castings joined to a central plenum. Sprays of recirculated

ALLIS-CHALMERS

Water Conditioning

ON THE JOB



Happy Solutions To 4 Typical Water Problems

● Everybody seems to have problems when they use water. It's too pure, or it isn't pure enough . . . or it needs conditioning for the job it has to do. In any case, a specialist is needed. Here are typical examples of Allis-Chalmers water conditioning service, equipment and chemicals at work solving varied water problems.

Drought Adds to Woes of River Water Users

CALIFORNIA—Things looked bad at a paper company when the first water samples came in. In fact, one water conditioning company went so far as to say that the alkalinity of the water could never be reduced to a satisfactory level.

But on the assurance of Allis-Chalmers experts, a de-alkalizer was ordered for boiler make-up water.

In the meantime there was a drought. The drought made the river water conditions even worse than they had been, so that by the time the equipment was installed there was real trouble with alkali.

Allis-Chalmers engineers had an unusually tough problem on their hands. Instruction, experiment, on-the-spot service, and a program of constant control have resulted in production of satisfactory boiler make-up.

Saved $60,000 in New Equipment

LOUISIANA—A low pressure industrial steam plant was being supplemented by a 1250-lb boiler. The question arose—can any of the old water conditioning system be used? Preliminary investigation indicated the need for demineralization equipment to get the desired water quality for make-up in the new equipment.

A survey of the records showed that it would be possible to use condensate from the low pressure system as make-up for the high pressure system. This solution of the problem required less modification of equipment than was originally anticipated . . . saved an estimated $60,000.

Stained Glass Has Its Place, But Not in Nursery

ILLINOIS—A nursery was spraying water over the outside of its glass hothouses to control the temperature inside. The method was effective, but the iron stains from the water were troublesome. Allis-Chalmers water conditioning experts recommended A-C's 130 Series complexing agents. This did the job by preventing the iron from depositing on the glass.

Battle with Algae Ends in Knockout

KENTUCKY—A petroleum company is finding out what a lethal weapon Allis-Chalmers new 120 Series algaecide really is. Previously they used sodium hypochlorite, but their cooling tower algae problems were not solved. Now they have complete control . . . using concentrations of only one-half of what is normally recommended. They also say it's easier to handle and apply, and better in every way, than anything they've ever used before.

Get Help on Your Water Problems

Whether you need chemicals, equipment or service, Allis-Chalmers provides an unbiased recommendation based on over 25 years' experience. No problem is too big or too small. Specialists are located in many cities. Call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5304

For more data circle 535 on Post Card

..but for long collector life

THE AEROTEC NEW 5 RWS

Aerotec's latest development in the field of erosion resistant dust collector tubes is unique.

Aerotec engineers proved, by accelerated tests under erosive conditions many times greater than normally encountered, that of all metals tested, white cast iron assures maximum resistance to abrasion.

These tests are substantiated by actual installations. They now establish the Aerotec 5 RWS collector with white iron tubes as the ultimate in long life and sustained high efficiency in the field of mechanical collection.

If your dust collection problem requires top mechanical efficiency, discover the assurance of highest performance and long life possible only with an Aerotec 5 RWS. Call or write our Project Engineers today. They are ready to help you solve your dust control problem.

Project Engineers **THE THERMIX CORPORATION** Greenwich, Conn.

(Offices in 38 principal cities)

Canadian Affiliates: T. C. CHOWN, LTD., 1440 S. Catherine St. W., Montreal, Que.

Manufacturers

THE AEROTEC CORPORATION

Greenwich, Conn.

For more data circle 536 on Post Card

water constantly drench these coils. Evaporation transfers heat of compression, at rate of about 1000 Btu per lb of water evaporated, to air stream. Air enters above coils, travels down through them and moves into central plenum dropping its entrained moisture, then turns upward and is ejected by a propeller fan.

Compressed air is cooled to a point close to wet bulb air temperature, it is explained, hence it is always cooled below ambient dry bulb temperature and no further condensation of moisture takes place in exposed air distribution lines. Jacket water is cooled to optimum temperature, controlled by modulating intake of outdoor air with dampers which automatically adjust capacity to cooling load and to outdoor wet bulb temperature. Shipping of cooler casing in flat panels reduces freight cost, and additional economies in installation and maintenance are noted. Installation may be indoors or out. Four sizes have capacities to 23,000 cfm of free air cooled from 275 to 85 F at 75 F wet bulb atmospheric. Niagara Blower Co.

25—DRAFT INDUCER designed for smaller heating plants

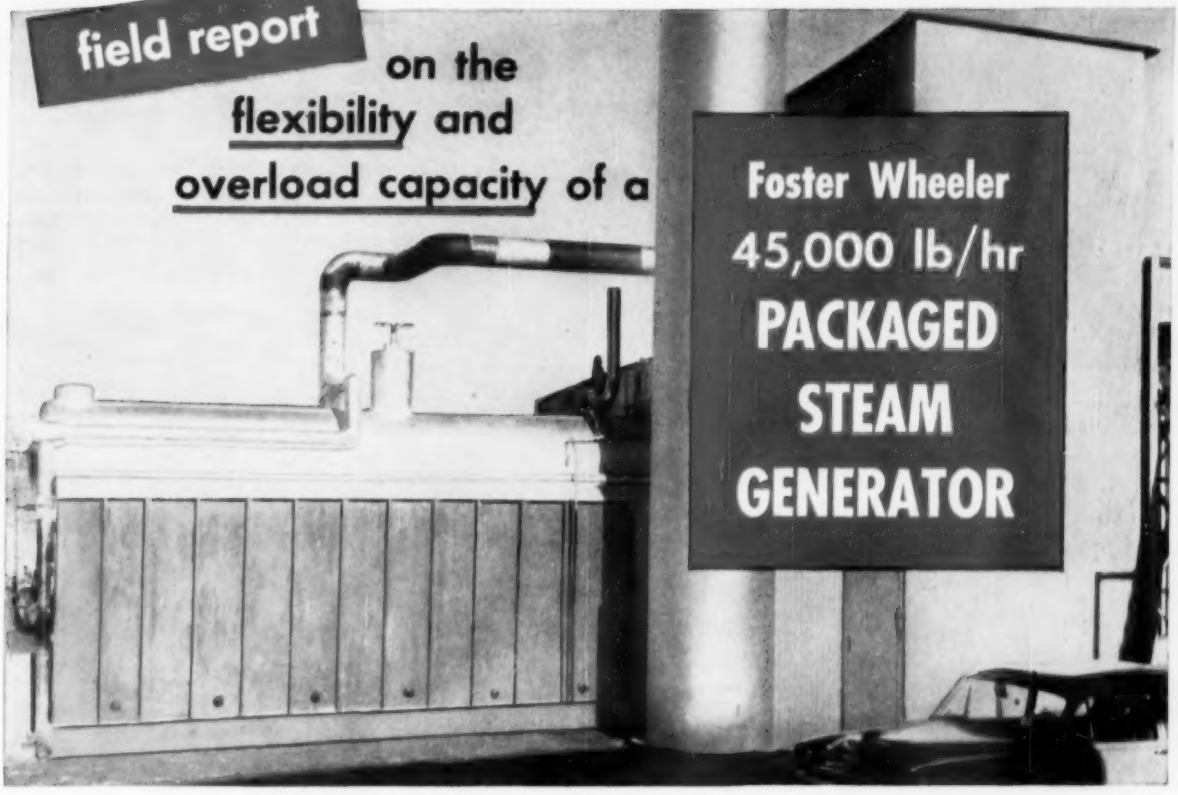
Model 10-D Draft Inducer are designed for small commercial heating plants, with capacities to 4½ gal of oil or 500 cu ft of 1000 Btu gas per hour. It gives

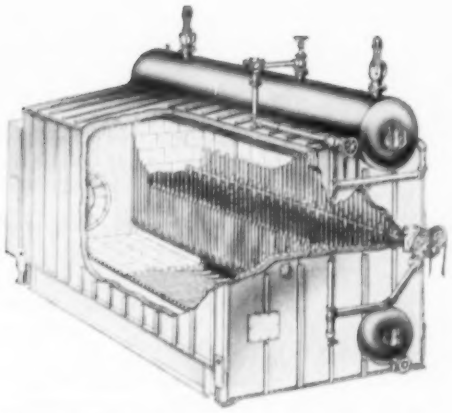
adequate draft at all times, manufacturer points out; also it assures better combustion and lower fuel consumption, eliminates need for tall chimneys or stacks and may be mounted horizontally or vertically in the breeching. A feature of the draft inducer is the fact that motor and fan assembly are in one unit, easily withdrawn from casing for inspection or servicing. The bearings are air cooled, fan needs no lubrication, and the unit's quiet operation makes it suitable for applications where low noise level is desirable, it is announced. Bulletin 10-D-57 gives more details. L. J. Wing Mfg. Co.

26—DEMINERALIZER designed to produce water of high purity

Purification by ion-exchange to produce water with resistance of over 1,000,000 ohms per cc is declared possible with the MM-O Mixed-Bed Regenerative Demineralizer. Cation and anion resins are mixed in one resin bed, permitting the ion-exchange process to take place hundreds of times as the water flows through. According to company, water of high electrical resistance with an almost constant pH level of 7 is produced. Manufacturer says that it removes ap-

field report on the flexibility and overload capacity of a Foster Wheeler 45,000 lb/hr PACKAGED STEAM GENERATOR





Cutaway drawing of FW Packaged Steam Generator of the type shown installed above at a large New England chemical plant. Except for the firing front, the entire unit is located out of doors. The performance tests mentioned here were made in December, under typical New England weather conditions.

FOSTER WHEELER engineers have conducted extensive performance tests on a 45,000 lb/hr oil-fired Packaged Steam Generator installed at a large New England chemical plant.

During a 30-day period, the unit was operated at 42,500 lb/hr on a 24-hour basis, delivering over 1,000,000 lb of steam per day. It was also operated at 46,500 lb/hr over an 8 hr period.

Efficiency at design load of 45,000 lb/hr exceeded contract requirements of 83.2%. During performance tests the boiler was operated in excess of 51,000 lb/hr at an efficiency of 82%.

Although purchased as a base load unit, tests were also conducted to determine its flexibility. Rapid load swings from 10,000 to 51,000 lb/hr were set up while on automatic control. The boiler was able to swing from one extreme to the other in considerably less than 60 seconds.

This very satisfactory performance stems from the conservative FW design and generous water storage capacity which are important features of the entire standard line. Available in rated capacities from 10,000 to 50,000 lb/hr, with wide choice of burners and controls. For complete information, send for Bulletin No. PG-55-3. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

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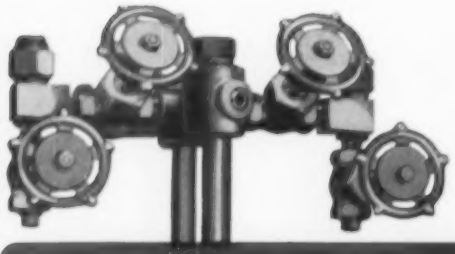
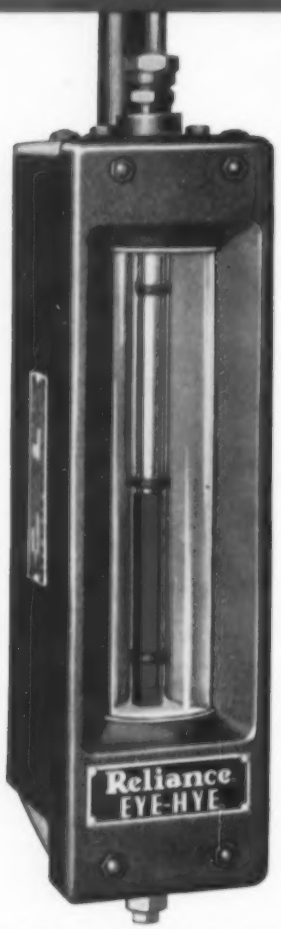


Models for panel or wall mounting

"Wouldn't operate my plant without them" says St. Louis engineer, of his

EYE-HYE® Remote Reading Indicators



This Reliance Gage, completely hydrostatic, assures safe, accurate reading of your boiler water levels

Here is easy natural reading (like conventional water gages) with perfect measurement and constant dependability. Twenty years on the market, and still increasing in use, here and abroad.

Simple as A-B-C, EYE-HYE indicates water level clearly by illuminated green fluid. Newly styled face plate gives wider angle of vision. And for extra safety, optional equipment adds auxiliary light signals and/or vibratory horns, reaching operators anywhere.

EYE-HYE serves main boilers — any pressure — and various power plant tanks and vessels in out-of-the-way places. Two EYE-HYEs are now acceptable under Boiler Code Case No. 1155 — eliminate maintenance of extra gage glass.

Rugged construction; no mechanical working parts; no adjustments on location; easy to maintain. Write for Bulletin CO today.

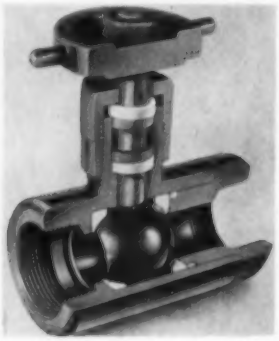
The Reliance Gauge Column Company • 5902 Carnegie Avenue • Cleveland 3, Ohio

For more data circle 538 on Post Card

proximately 1100 grains per regeneration. Unit consists of transparent plastic column on a plastic base with molded plastic fittings, and is shipped as a complete unit with plastic tubing and distributor to aid in regenerating resins. Flow rate of the unit is from 10 to 30 gph. Barnstead Still & Demineralizer Co.

27—PVC BALL VALVES handle difficult fluids

This valve combines company's "double-seal" ball valve design principle with material suited for handling corrosive and other difficult fluids. It is



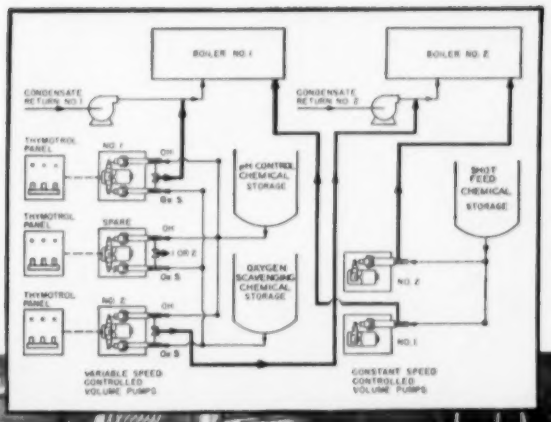
suggested for use in many plastic or metal piping systems for vacuum or pressure service. Full flow, quarterturn shut-off, with thousands of leaktight cycles and no maintenance are features claimed. Valve seats are replaceable. Rating is 150 psi at ambient temperatures and 50 psi at 130 F. Sizes $\frac{1}{2}$ to 2 in. in screwed ends are now available. Flanged and weld ends and larger sizes are also planned. Jamesbury Corp.

Described on these pages are new and improved products. Use Reader Service Cards on pages 139–140 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

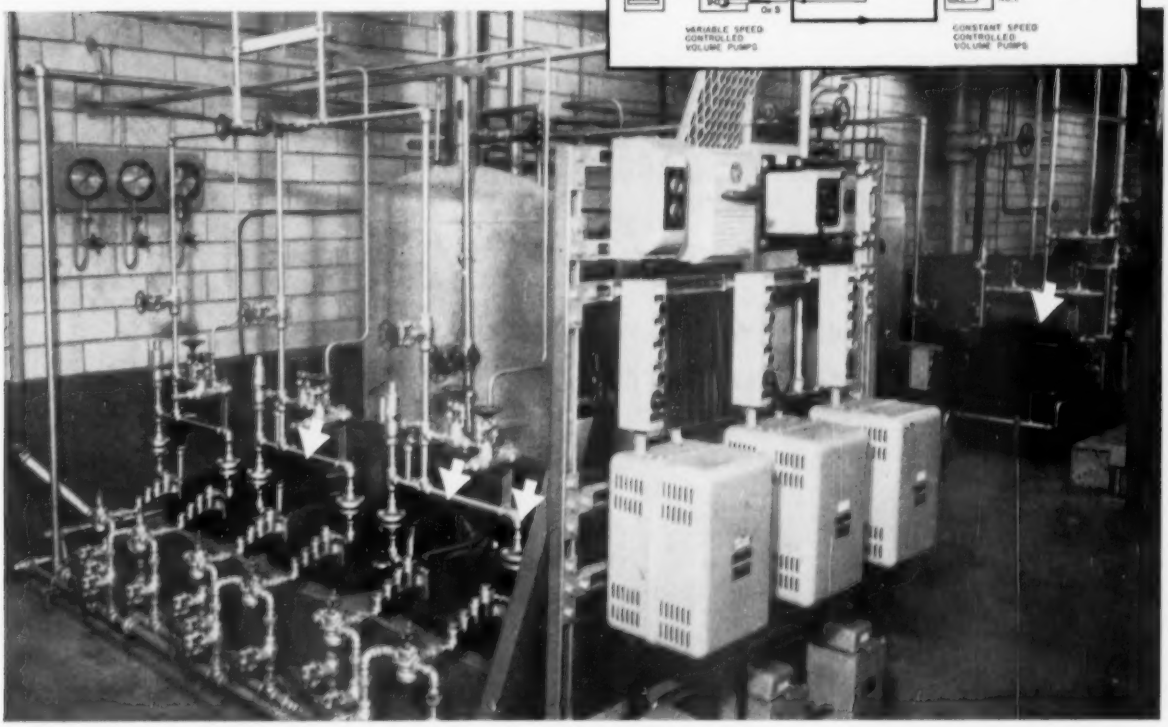
28—PNEUMATIC TRANSMITTERS add vector to null balance

These pressure and differential pressure transmitters utilize a "null-balance-vector" principle. According to manufacturer, this design principle results in more compactness, and less weight and permits stepless changing of each instrument's range with a simple screwdriver adjustment. The latter is accomplished by changing the angle at which input forces are applied to the linkage, thereby altering the component of such forces that must be balanced. Standard models of both instruments operate on 20 psi air and produce output signals from 3 to 15 psi, normally using about 0.2 scfm of air.

Virtually all parts of the two instruments are interchangeable, except primary measuring elements. The latter include a diaphragm assembly for pressure differential measurement, and bourdon tubes, bellows or diaphragm for measurement of pressure. It is explained



Boiler water treatment installation of Controlled Volume Pumps at a major utility.



Save chemicals in boiler water treatment with Controlled Volume Pumps

Controlled Volume Pumps efficiently deliver the small quantities of treating chemicals required to protect boilers from scale, embrittlement, corrosion and pitting. They meter and pump chemicals in measured volumes directly into high pressure feedwater lines . . . within an accuracy of ± 1%.

The accuracy of Milton Roy Controlled Volume Pumps puts chemicals to work in the *exact* quantities required . . . keeps chemical consumption at a minimum.

Milton Roy designs and fabricates complete packaged systems for the treatment of boiler feedwater. Check with your water treatment specialist for the system best suited to your station.

Send for Bulletin 953, "Controlled Volume Pumps for Water Treating Systems."

Milton Roy Company, *Manufacturing Engineers*, 1300 East Mermaid Lane, Philadelphia 18, Pa.

milton Roy
CHEMICAL FEED SYSTEMS

Engineering representatives in the United States, Canada, Mexico, Europe, Asia, South America, Australia, Africa.

For more data circle 539 on Post Card

YEARS without Patching

when brick is set up with Super #3000

BONDING MORTAR

CASE HISTORIES

• The fire brick wall of an oil-fired boiler, set with Super #3000, has remained in excellent condition without patching, for more than 5 years.

• A boiler ignition arch of a large boiler required replacement of its nose brick at least twice a year. After being bonded in place with Super #3000, nose brick has remained in uninterrupted service even after 2 years.

• Baffle tile in a large, oil-fired boiler, previously a constant trouble spot, was bonded and wash-coated with Super #3000. After 2 years, tile was still intact and tight.

Write for brochure

Air sets weld-tight, to highest dried density. It does not spall, shrink or crack at low, medium or high temperatures to 3000° F. Has unsurpassed strength—high heat resistance to flame erosion and mechanical abrasion.

REFRACTORY & INSULATION CORP.

R&I

REFRACTORY BONDING AND CASTABLE CEMENTS
INSULATING BLOCK, BLANKETS AND CEMENTS

130 WALL STREET • NEW YORK 5, N.Y.

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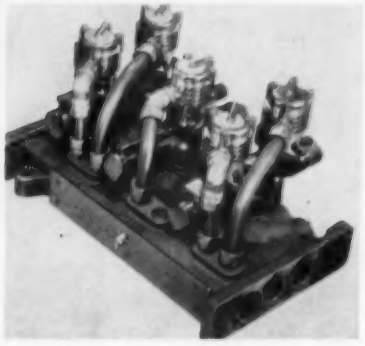
that since the instruments balance forces, primary fluid flows are nearly zero; hence, contamination of measuring elements is eliminated. Applicable to flow, pressure or differential pressure transmitting jobs, this new family of instruments is reported especially valuable where operating ranges may change. Folios 5612 and 56-13A give data. Republic Flow Meters Co.

29—MANIFOLD affords economical mounting of valves

This manifold is designed to afford economical and efficient multiple mounting of company's Speed King 2, 3 or 4-Way Valves in any desired combination. Available in 2- and 3-station types, the cast aluminum manifold has full

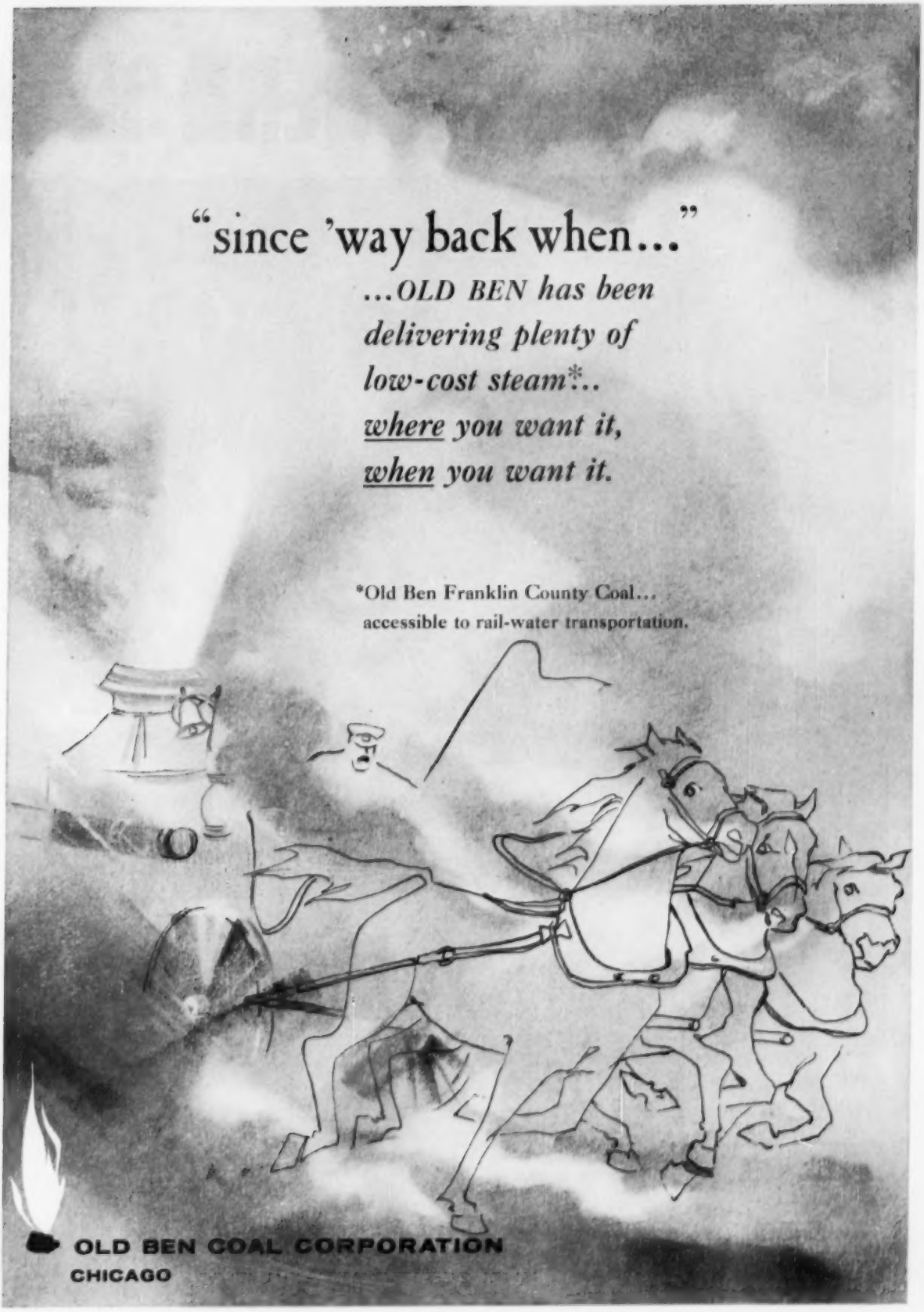


length inlet and exhaust ports, both 1 in. NPT, common to all valve stations. Electrical wiring is run through a 1¼ in. NPT conduit passage, with one access cover for all stations to simplify wiring. Pilot solenoid leads are enclosed in flexible conduit. Manifolds are designed with side or bottom cylinder porting to facilitate piping. Holes for mounting manifold and valve assembly are also provided. According to manufacturer, manifold can be adapted to any type of control valve application. Combinations of single or double solenoid valves can be mounted at any station on manifold. Remote operated, speed controlled and oil pilot Speed King Valves also are suitable for installation. Valvair Corp.

30—OIL SWITCH for remote control of capacitors

For economical switching of capacitors, outdoor lighting and load break applications, this oil switch is announced as a single-phase, 14.4 kv unit with continuous current rating of 200 amp, and a momentary rating of 9000 amp RMS symmetrical. Motor mechanism of the switch can be controlled by a thermostat, voltmeter, ammeter or time switch, and can be removed by loosening two mounting screws. Nitrile rubber gaskets on cover and bushing are used for sealing. The operating shaft handle utilizes a "one-way" seal to permit venting of internal pressure and minimize thermal-cycle breathing. Reduced maintenance is attributed to use of a printed circuit in the operating mechanism which reduces number of mechanical links normally associated with the operating mechanism. The tank of this switch is supplied with about 1½ gal inhibited oil. General Electric Co.

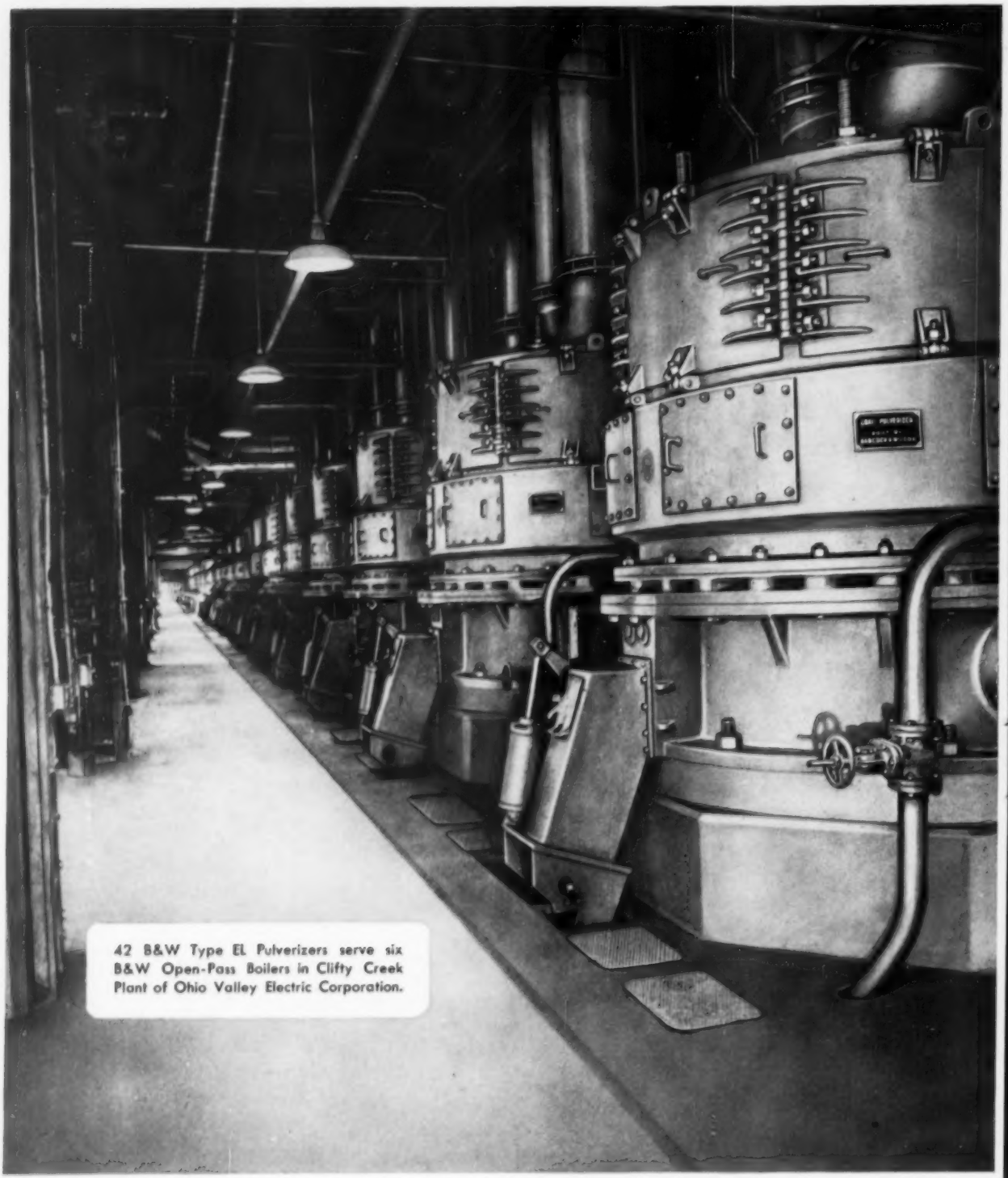
more Equipment News on page 134



For more data circle 541 on Post Card

Have You Investigated

THE MODERN B&W



42 B&W Type EL Pulverizers serve six B&W Open-Pass Boilers in Clifty Creek Plant of Ohio Valley Electric Corporation.

DIRECT-FIRING SYSTEM?

A Compact, Space-Saving Package of Efficient Grinding Power

More power and capacity in a compact arrangement . . . long-range dependability . . . reduced operating cost — these are the measurable results of continuous, intensive development of the modern B&W Pulverizer. It has established an outstanding production and efficiency record in thousands of commercial installations. Here are some reasons why:

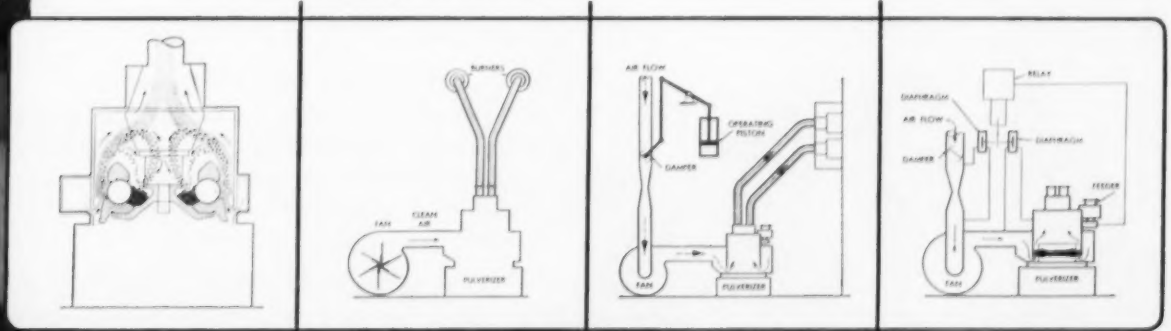
Continuous High Fineness Over Entire Service Life: Efficient combustion requires high fineness at all times. The high circulating load of the B&W Pulverizer permits efficient and dependable classification of product, so that only material of proper fineness leaves the unit. In addition, its slow-speed, spring-loaded ball bearing grinding elements maintain proper grinding contact throughout their service life.

Handles Wide Variety of Low Grade and Wet Coal: Regardless of the coal's grade or whether it's dry or soaking wet, the B&W Pulverizer's unique and exclusive recirculation of fuel through heated air assures efficient grinding . . . eliminates shutdown, capacity loss, or special attention from operators.

Simplicity of Arrangement and Reduced Maintenance: Accessibility for all normal maintenance makes it simple, quick, safe and low-cost. Adjustments are easily made while the unit is in operation. Using only clean primary air supplied under pressure, fan maintenance is substantially reduced and fuel piping is greatly simplified. Also, with the pulverizer acting as its own distributor, no special distributing devices are needed. Grinding elements are of special alloy material. They last two years or more on eastern coals and at least a year on midwestern coals.

Adaptable to All Types of Automatic Controls: Because it features "one point contact with the boiler," operation of the B&W Pulverizer is simple. The boiler's automatic combustion control is connected to the pulverizer at only one point—the damper in the primary-air duct. The pulverizer's own control system regulates all other functions, such as maintenance of proper fuel-air ratio and operating temperature.

SEND FOR DATA. For full information about the B&W Type EL Pulverizer and Pulverized-Fuel Firing Systems, write: The Babcock & Wilcox Company, 161 E. 42nd Street, New York 17, N. Y.



COAL RECIRCULATION — this means high fineness, aids drying.

PRESSURE SYSTEM — this eliminates fan wear, simplifies piping.

AIR CONTROL—this means one, simple control contact point.

MILL LEVEL CONTROL — this automatically adjusts fuel-feed.

BABCOCK & WILCOX

BOILER DIVISION

G-766

For more data circle 542 on Post Card

ONE-TON TEST

proves physical strength of "Integrated" field coils in ALLIS-CHALMERS MOTORS

It's not likely a field coil of a motor would ever be punished this way. But tests like this illustrate the inherent ability of Allis-Chalmers "INTEGRATED" FIELD COILS to withstand the stresses created by the most severe loading conditions of a motor.

Available only on Allis-Chalmers Motors

"Integrated" field coils, available only on Allis-Chalmers motors, are enveloped in oriented glass fibers and heat-stabilized resins. These are securely locked to poles to resist mechanical force. High dimensional stability and tensile strength characteristics assure long life under the toughest of operating conditions.

Coils are surface sealed against atmospheric contaminants. In addition, the coefficient of expansion of insulation is similar to that of copper. Heat transfer qualities are excellent. "Integrated" coil structures can withstand the most severe thermal cycling found in normal operation.

Exclusive Allis-Chalmers

"Double-protection," combining new "Integrated" field coils with *Silco-Flex* all-silicone stator coil insulation, is available for rotating and stationary elements of large ac or dc machines with operating temperatures through Class B range.

For the whole story of Allis-Chalmers motors, contact your local A-C representative or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Silco-Flex is an Allis-Chalmers trademark.

ALLIS-CHALMERS

A-5276

For more data circle 543 on Post Card

How Aitkin Light Plant came to choose STANODIESEL Oil M

Case story of exceptional results obtained with Standard Oil diesel lubricants

Because of plant operating conditions and generator capacity installed, Aitkin, Minnesota, Municipal Light and Power Plant had to operate a 1,235 H.P. Worthington engine over 38,000 hours before it could be taken out of service for complete overhaul. During that time, 19.2 million K.W.H. were generated. STANDARD HD Oil, predecessor to STANODIESEL Oil M was the lubricant.

When the engine was overhauled, all pistons were in good condition. All rings were free to move in ring grooves. There were no scars on cylinder liners. Piston walls were bright, wear was even. Based on this performance from STANDARD HD, plant management converted to the improved new oil—STANODIESEL Oil M—at the time of overhaul. STANODIESEL Oil M has been giving top performance ever since.

STANODIESEL Oil M is made from highest quality base stock. Additives help the oil resist viscosity change and keep parts clean. Other additives control foam, keep highly stressed parts lubricated.

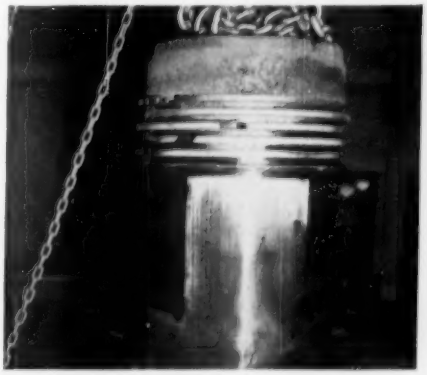
Get more information about STANODIESEL Oil M from your Standard Oil industrial lubrication specialist. There is one near you in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY
(Indiana)

STANDARD

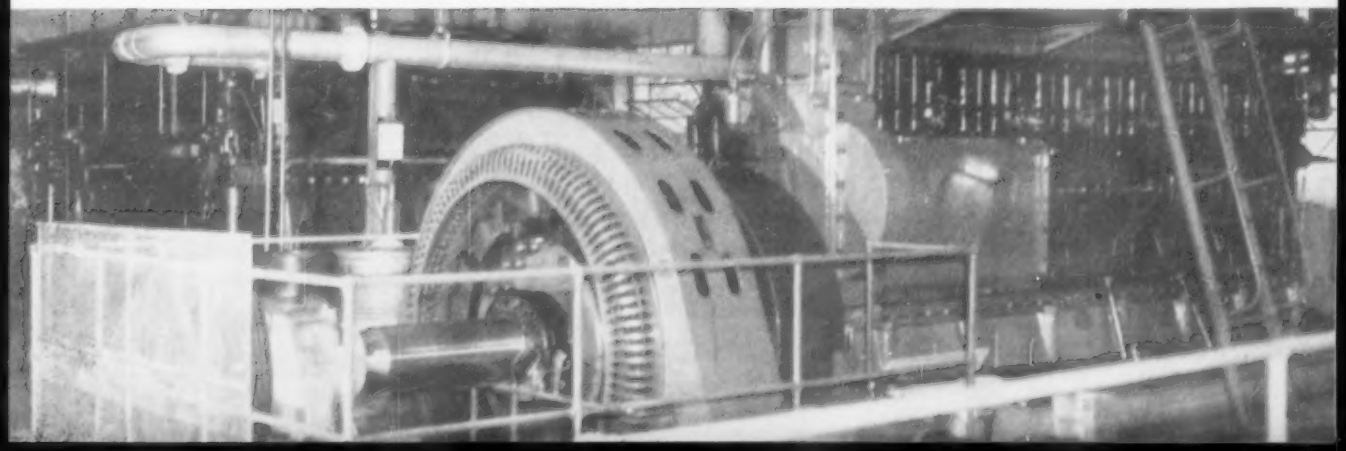
John Acklestad, Aitkin plant superintendent, and Carl Klenner (left) Standard Oil industrial lubrication specialist check engine service record. Carl has been rendering technical service on lubrication problems at Standard Oil for eight years. He has a degree from the Michigan College of Mining and Technology and has completed the Standard Oil Sales Engineering School.

"As is" photo of piston removed from engine after 38,000 hours of service. Rings were free.



Quick facts about
STANODIESEL Oil M

- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by use of economy fuels.
- Maintains film on difficult to lubricate areas and parts.
- Eliminates spark plug fouling in spark ignited gas engines and reduces combustion chamber ash and deposits in engines burning natural gas, LPG and liquid fuels.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil commingle.



PATTERN OF COAL-HANDLING EFFICIENCY

You know the job is done right from the ground up when you maintain coal storage piles with an Allis-Chalmers HD-21. This 204-hp tractor has the power to move big loads efficiently and it just naturally builds a storage pile as it should be built.

Repeated trips over the coal pile spread and compact coal in horizontal layers, eliminate flues and voids . . . prevent spontaneous combustion. Torque converter drive enables the HD-21 to ease into big loads without track spinning . . . to work at its most productive speed without time-outs for shifting.

Standard dozer blade easily rolls as much as ten tons at a pass. Special coal-handling blade takes full advantage of the machine's ability . . . moves 15 tons at a time. Ask your Allis-Chalmers construction machinery dealer to show you this efficient machine in action. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS *Engineering in Action*

For more data circle 545 on Post Card

Hall Industrial Water Report

VOLUME 5 APRIL 1957 NUMBER 2

A New Broom Sweeps Water Clean

Coagulant aids are not new, but, just as in the old saying, the newer types of coagulant aids are helping the common coagulants to sweep water freer of suspended matter at lower chemical and operating costs and higher clarifier flow rates. The cleaner water solves problems wherever water is used; in boilers, municipal systems, cooling systems, waste disposal, oil well floods. Hall Laboratories engineers are fully informed on what various aids can do and are ready to help you with your clarification problems.

Flow Rate Doubled With Coagulant Aid

Carryover of floc from large clarifiers in a southern plant was a serious problem because the suspended material adsorbed from the water the glassy phosphate added for control of corrosion in the extensive cooling system.

Water used for cooling purposes was clarified with ferric sulfate and ground calcite. There were no filters, so good clarifier operation was essential. But the floc formed was so fragile and had such poor settling characteristics that the plant operated at one-half capacity part of the time to avoid losing the sludge blanket. During these periods one-half of the cooling water used was not clarified.

Hall Engineers M. C. Scott and V. M. Marcy substituted 6 ppm of a Hagan Coagulant Aid for the calcite. The large, tough floc resulting permitted operation of the clarifiers at full load and with greatly reduced chemical feed.

A water of satisfactory quality is now being produced at a saving of approximately 50 per cent in chemical cost. As a bonus, there are potentially greater savings resulting from the improved water conditions and protection from corrosion.

From Muddy River To Deionized Water

The water used in the electrolytic tinning lines at a Pennsylvania steel mill must be free from suspended material and low in dissolved solids. To make water of such high quality requires complete clarification and deionization.

Until approximately a year ago the first important step of removing suspended matter from the muddy river water was accomplished with aluminum sulfate and lime in clarifiers. The quality of the water going to the deionizers was not all that it should be because the sludge blankets were sensitive to increase in upflow rates and there was trouble with settling of floc.

Hall engineer D. E. Noll recommended the use of a Hagan Coagulant Aid to improve clarifier operation. Results were successful. The sludge blankets stabilized and the floc toughened and settled more rapidly. Time-consuming jar testing previously used for control has been completely eliminated. Feeds of aluminum sulfate and lime were reduced approximately 30 per cent with corresponding reduction in chemical handling and storage space.

An additional saving resulted from reduction in regeneration chemical cost at the deionizing plant. Coagulant aid has surely carved a niche for itself in this plant.

Clarifying Potable Water

A Western Pennsylvania municipal water plant had trouble with floc formation when clarifying with lime and aluminum sulfate. This plant clarifies and filters 15 to 20 mgd of river water in a conventional sedimentation basin. Coagulant aids have eliminated the difficulty. Operating experience showed that both activated silica and a Hagan Coagulant Aid greatly improved floc formation at approximately the same chemical cost. The plant chose Hagan Coagulant Aid because operating cost was reduced by dry-feeding it in comparison with the more time-consuming task of preparing the activated silica sol.

An Aid to Silica Removal

Turbidity in the effluent from the hot-process unit was affecting silica removal at a paper mill in Virginia. Carryover of suspended material became particularly severe on sudden load surges. Often the particles were so finely divided that they passed through the anthracite filters to the paper mill boilers.

The raw makeup water for the 600-psig boilers contains 230 ppm bicarbonate, 30 ppm silica, practically zero hardness, and about 3 ppm of naturally occurring phosphate. Hydrogen cycle exchangers reduce the high alkalinity, while the following treatment with caustic soda and magnesium sulfate and oxide in the hot process unit reduces the silica concentration of the filter effluent to about 2 ppm.

Hall engineer C. F. Raines decided to try a Hagan Coagulant Aid for better settling of suspended matter in the hot-process unit, even though there had been no previous experience with the Hagan aid for such an application.

A few ppm produced amazing results. The effluent from the unit was clear even before filtration and the filter effluent was sparkling clear.

In addition to reducing sludge carry-over, the 8-10 ppm coagulant aid feed resulted in the same degree of silica removal with 15 per cent less magnesium salts.

Both the plant operating staff and engineer Raines are justifiably pleased with the truly outstanding improvement in water conditions.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information write, wire or call Hall Laboratories, Division of Hagan Chemicals & Controls, Inc., Hagan Building, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Use it wisely.

Hall Laboratories—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

For more data circle 546 on Post Card

Can I use this sheet packing on hot oil lines, too?
Sure J-M Service Sheet is equally good for oil, steam and gas lines!
Johns Manville

Your J-M Packings Distributor can tell you why this quality sheet packing has maintained such an excellent reputation for over 35 years

Where it's used: Every industrial plant can use J-M Service Sheet Packing to advantage. It's the favorite packing of thousands of plant engineers and maintenance men. Both versatile and dependable, Service Sheet makes a tight, long-lasting seal against superheated steam, air, gas, water, hot oil and ammonia, as well as many acids and chemicals.

What its advantages are: J-M Service Sheet is a quality packing, made of selected long-fibre asbestos bonded with heat-resisting compounds. It is graphited on one side to permit breaking a joint without destroying the gasket. The ungraphited side is ruled into one-inch squares to speed cutting and reduce waste. And . . . you can order it in large economical quantities because J-M Service Sheet will not dry out in stock!

How it is furnished: Service Sheet is supplied in sheets 54″ x 63″, 36″ x 126″, 36″ x 63″, and 54″ x 126″ sheets in thicknesses of 1/64″ to ¼″ and 108″ x 126″ sheets in thicknesses of 1/32″ to ¼″. It is also furnished as cut gaskets in standard and special shapes. See the J-M catalog for further details.

Your J-M Packings Distributor carries complete stocks of J-M Service Sheet and other quality Johns-Manville Packings. He can help you choose the right packing for your application. Write him for complete information and copy of folder PK-19A, "Thousands of Plants Rate It Tops." Or address Johns-Manville, Box 14, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

For more data circle 547 on Post Card

Alumalife® Case

Phenol Case

Why do ASHCROFT DURAGAUGE CASES increase service life?

Duragauge casings add extra-long service life to Duragauges because they're available in three different materials: you can choose the case-material that stands up best in *your application*. You have a choice of *Alumalife®* – a special aluminum alloy; *Cast Iron*, rugged and durable; and *Phenol*, a tough, rigid plastic.

Duragauge casings are dust and moistureproof. Chrome-plated, die-cast retaining rings keep the dial cover glass tightly in position and prevent the entrance of dirt or harmful fumes. Depending upon material, casings are Bonderized and the ring is Anodized and dichromate sealed for protection from corrosion.

For added protection, there is the Maxisafe Duragauge casing with a solid front – a special design for maximum safety and ease of maintenance. Duragauges are easy to service since Duragauge casings are constructed so that the entire system – socket, tube, tip, movement, dial and pointer – can easily be removed as a unit.

Lifetime Duragauge cases are available for numerous dial sizes. You have a choice of Bourdon tube materials, a wide range of pressures, and a movement made completely of stainless steel or stainless steel with nylon bearings and pinion gear.

Whatever case material and gauge system is best for your needs, you can rely on the Ashcroft Duragauge for highest sustained accuracy and long service life.

FOR PROMPT ASSISTANCE in selecting the right Ashcroft Duragauges for your specific needs, depend on the experience of your Industrial Supply Distributor. He is as close as your telephone.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROLS PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

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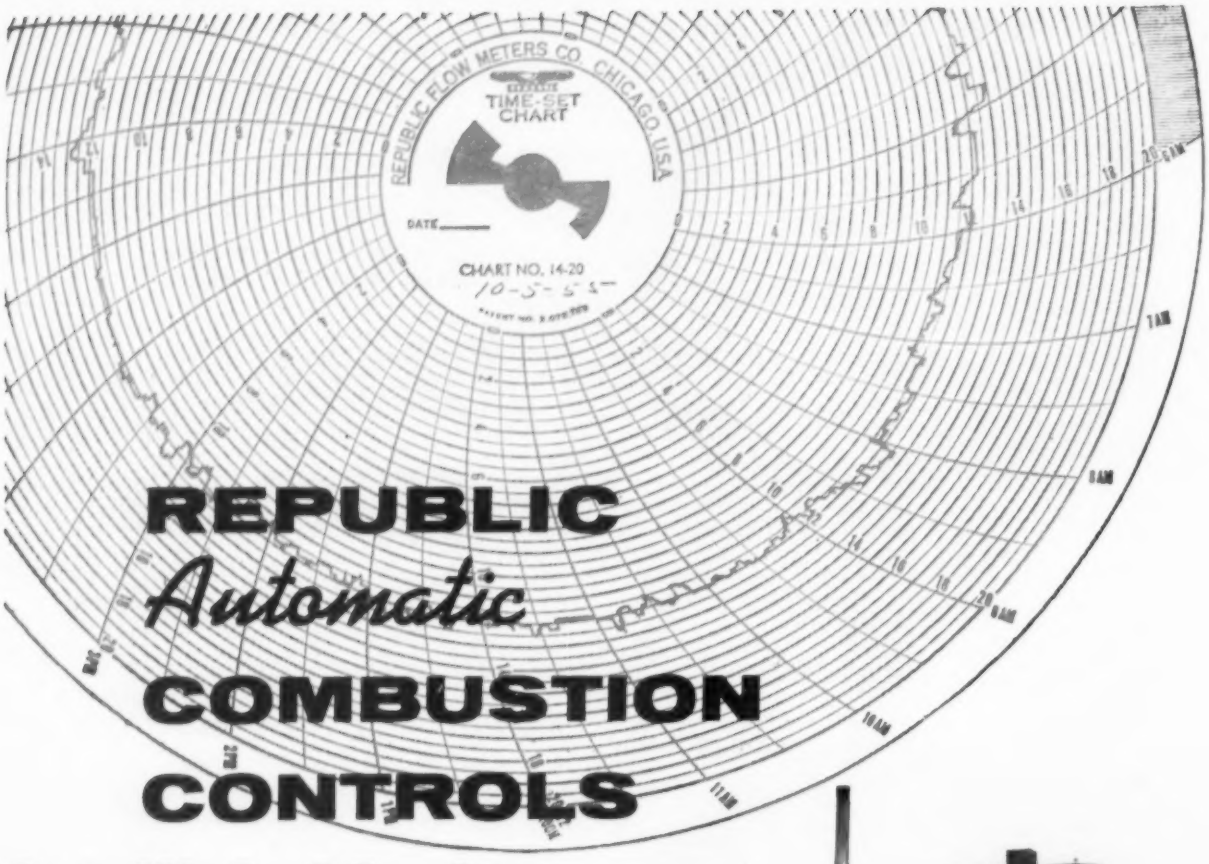
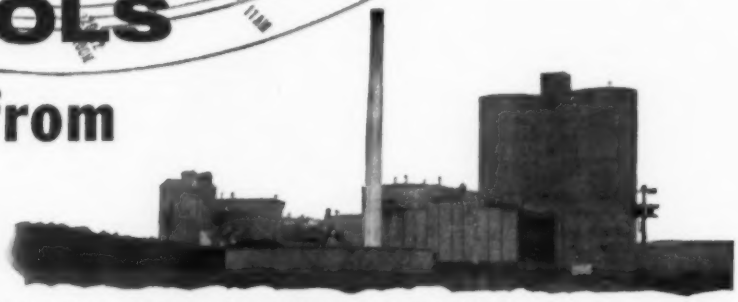


REPUBLIC *Automatic* COMBUSTION CONTROLS

Get High CO_2 from Low Grade Coal



at UTAH-IDAHO SUGAR COMPANY'S NEW $7,000,000 PLANT

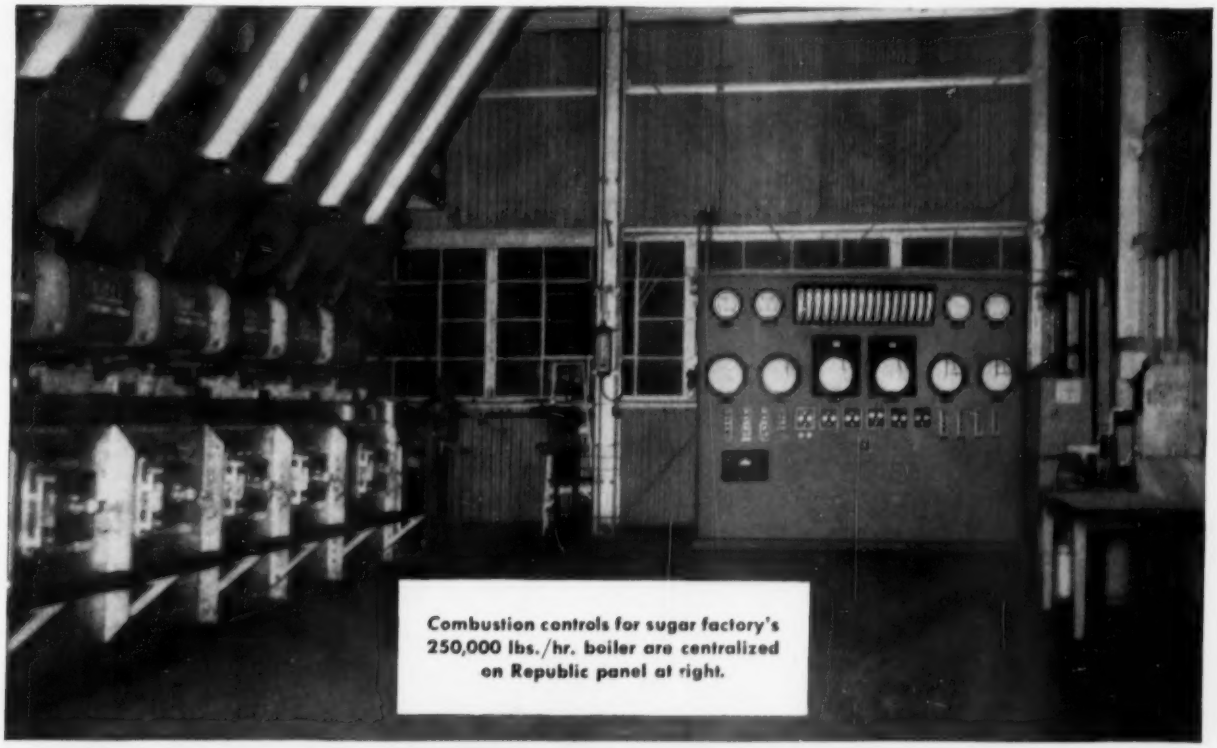
In any power plant, the percentage of CO_2 in combustion gases is indicative of combustion efficiency. But at the power plant for Utah-Idaho Sugar Company's new sugar beet factory, Moses Lake, Washington, a good CO_2 performance record is more than desirable. It's actually essential! That's because the plant supplies not only steam, but CO_2 as well to sugar-making processes. The CO_2 is extracted from combustion gases and becomes a vital ingredient in the production of over 75,000,000 lbs. of sugar and thousands of tons of molasses the factory produces annually. With the plant limited to low grade western coal, continuous maximum combustion efficiency at all loads is necessary to insure adequate CO_2 for processes.

Republic Automatic Combustion Controls enable the plant's spread stoker fired 250,000 lbs./hr. boiler

operating at 400 psig and 575°F. to meet CO_2 requirements while matching steam supply to process demands. Daily CO_2 charts indicate the boiler is consistently producing 12–13% CO_2 in spite of the quality of coal burned.

According to operators, ash removal, cleaning of the fire and soot blowing can be carried out with the combustion controls on automatic without disturbing the fuel-air ratio. Furnace draft is controlled satisfactorily despite the high stack on the plant. Turbine drives on forced and induced draft fans are speed controlled by the combustion controls, eliminating the need for dampers. A three element Republic boiler feedwater system is also tied in with the combustion control system to automatically supply the proper amount of water to the boiler at all steaming rates.

This plant is one more example of how Republic combustion engineers design control systems that enable boilers to exactly meet individual plant requirements. There are Republic Combustion Controls for any size or type of boiler, for all methods of fuel firing, all arrangements of draft and all load conditions. When you want to be sure of getting maximum boiler performance, ask Republic to design and build your combustion control system.



Combustion controls for sugar factory's 250,000 lbs./hr. boiler are centralized on Republic panel at right.

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois

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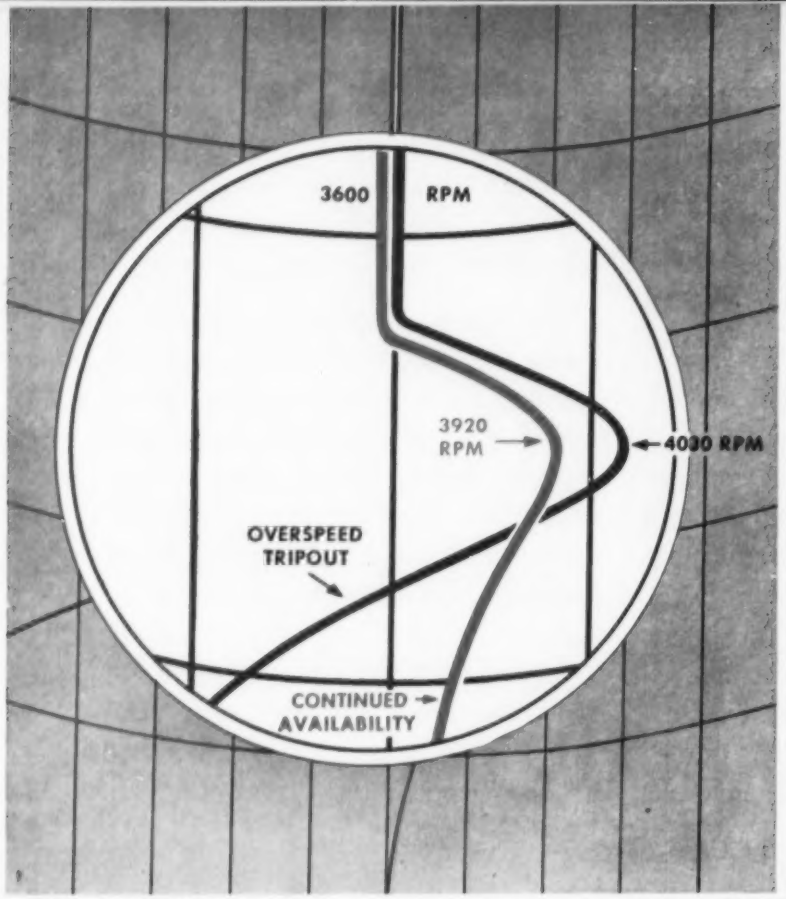
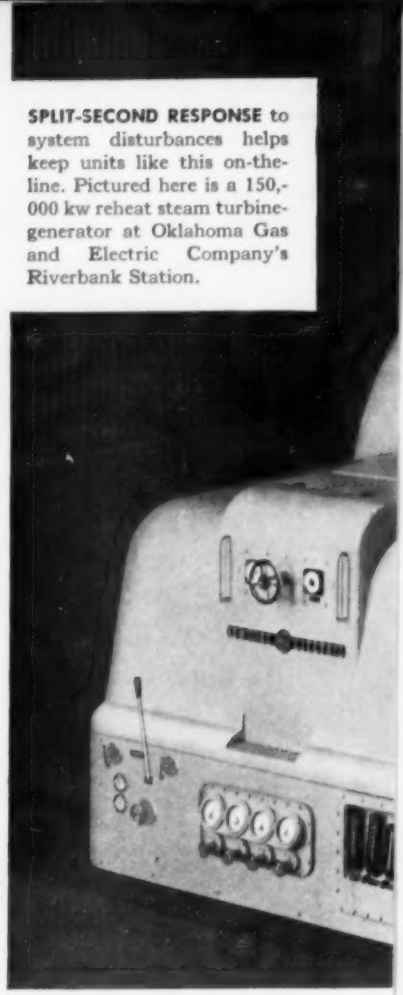
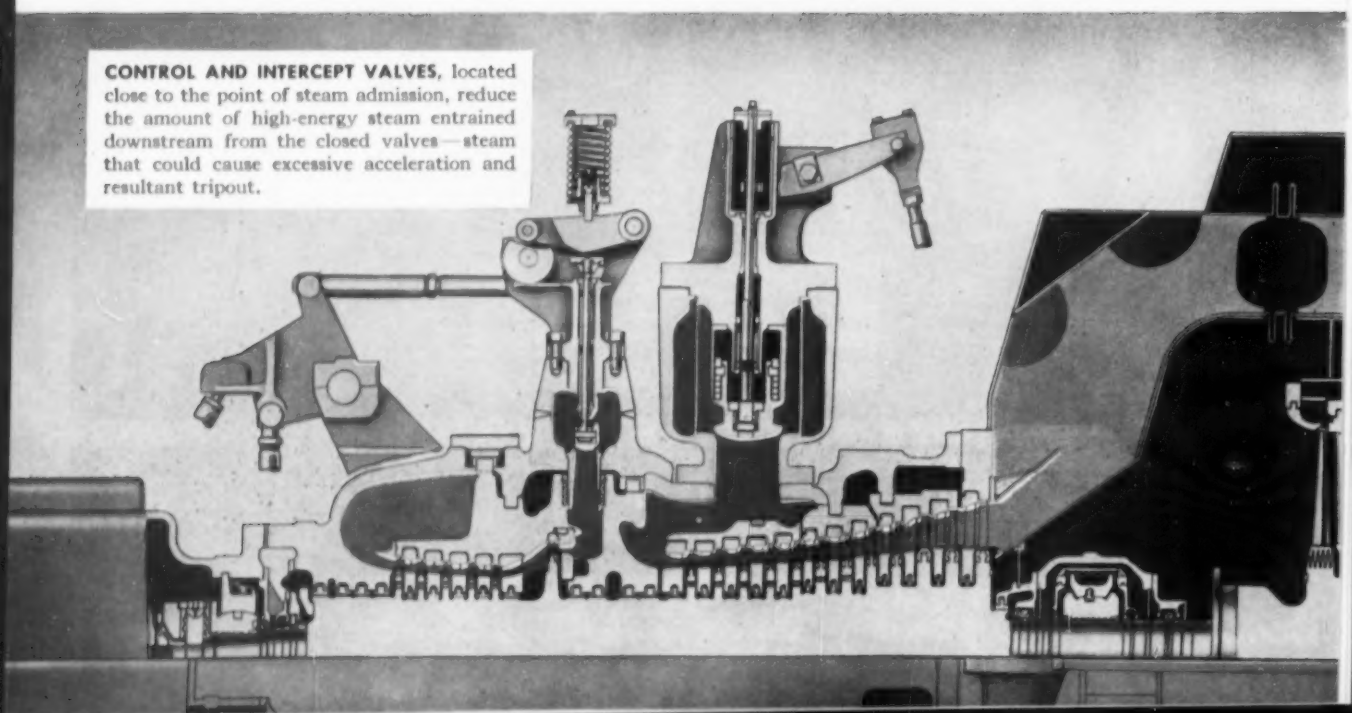


SENSITIVE GOVERNING SYSTEM helps avoid costly tripouts. The red curve, above, shows how a typical G-E reheat turbine stays below tripout speed by limiting speed to 3920 rpm during temporary system interruption. Without this split-second governing response, overspeed to 4030 rpm can result in costly shutdown.

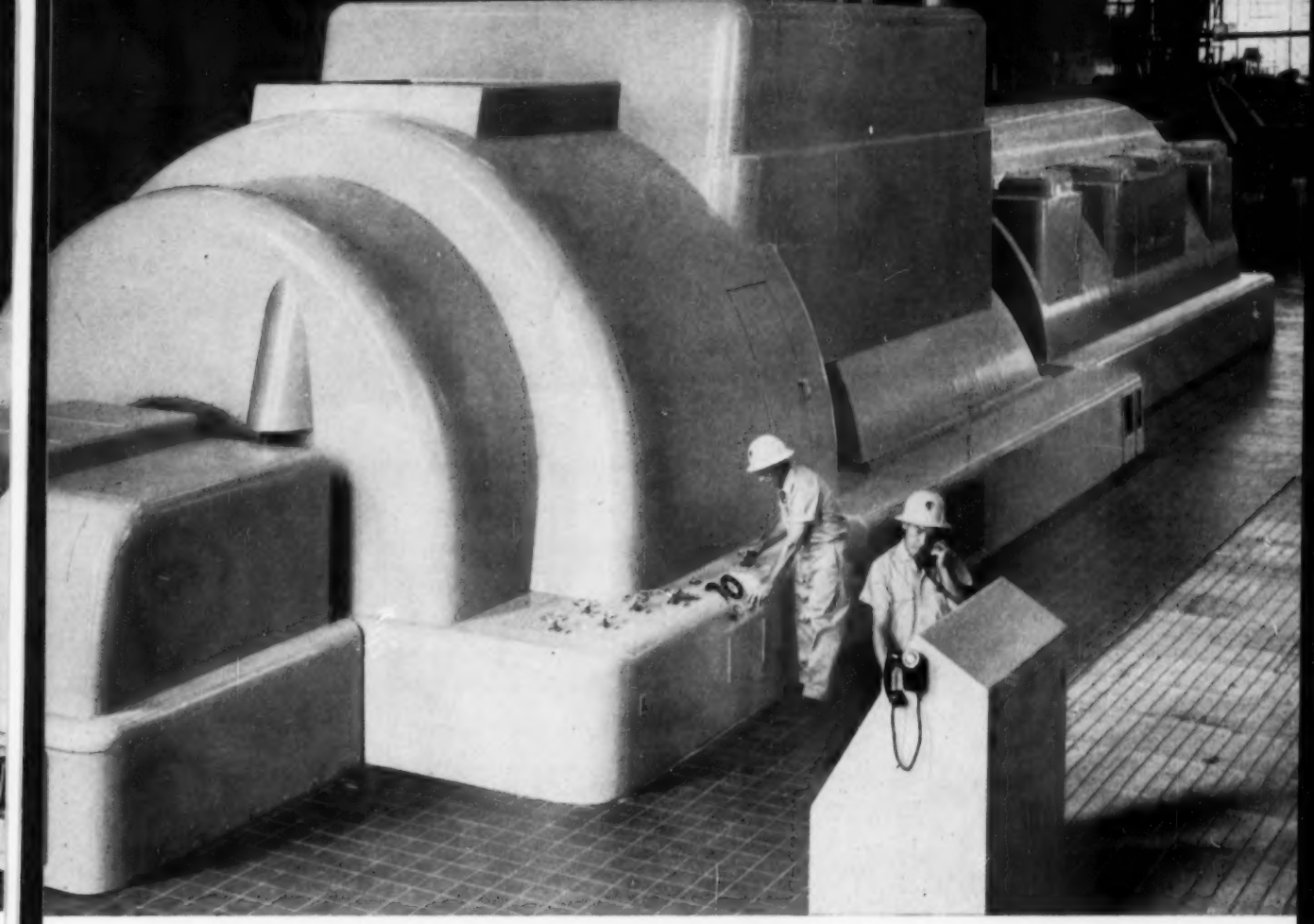


SPLIT-SECOND RESPONSE to system disturbances helps keep units like this on-the-line. Pictured here is a 150,000 kw reheat steam turbine-generator at Oklahoma Gas and Electric Company's Riverbank Station.

Split-second response helps keep



CONTROL AND INTERCEPT VALVES, located close to the point of steam admission, reduce the amount of high-energy steam entrained downstream from the closed valves—steam that could cause excessive acceleration and resultant tripout.



General Electric turbines on-the-line

SENSITIVE GOVERNING SYSTEM COPES WITH TEMPORARY SYSTEM DISTURBANCES

Requirements for sensitive, faster-responding governing systems have steadily increased with the trend toward larger reheat turbines with their inherent high overspeed potential.

Modern turbines entrain significant quantities of high-energy steam downstream from control and intercept valves and in crossover pipes. Because this steam can cause rapid acceleration upon load loss, governing systems must instantly sense speed changes to ride through temporary system disturbances. A split-second time lag may mean the difference between tripout and continued turbine availability.

Locating control and intercept valves as close as possible to the turbine operating stages reduces the amount of high-energy steam trapped downstream from the valves. With the acceleration potential of this entrained steam kept to a minimum, overspeed is limited and the turbine remains on governor control despite temporary system interruptions.

Other refinements such as use of an extremely sensitive governor and relays help make fast response possible. This governor senses the slightest change in speed and transmits a signal to activate the governing system.

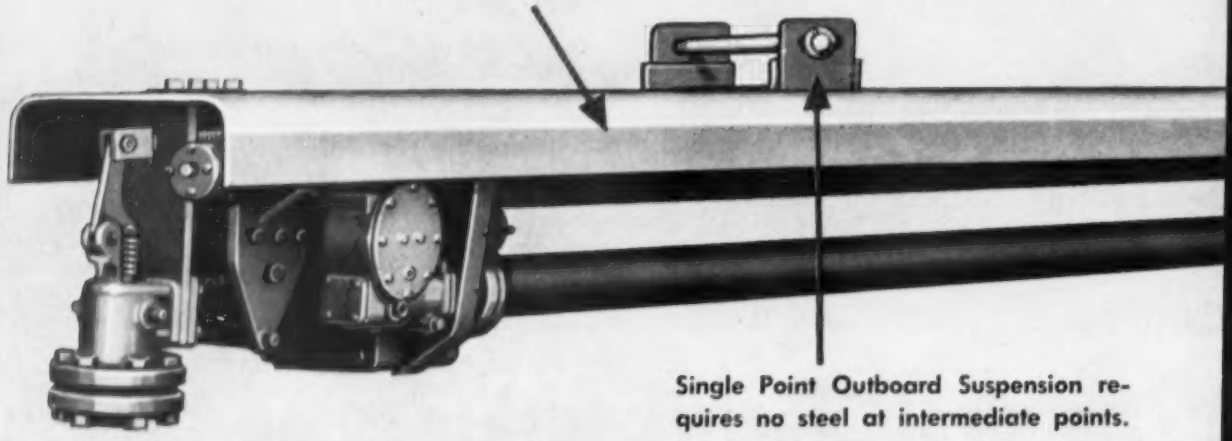
Sensitive response of governing systems is another example of how General Electric turbine research and engineering leadership combine to build tomorrow's turbine-generators today. For further information on reheat turbine overspeed protection, write for bulletin GER-920, Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, New York. 254-39

Progress Is Our Most Important Product

GENERAL ELECTRIC

Backbone and Protective Cover

Top Cover is an integral part of the structural "Backbone" of the blower unit that assures greater rigidity. It also provides protection from dirt, damage, the elements, and personnel hazard . . . with improved appearance.



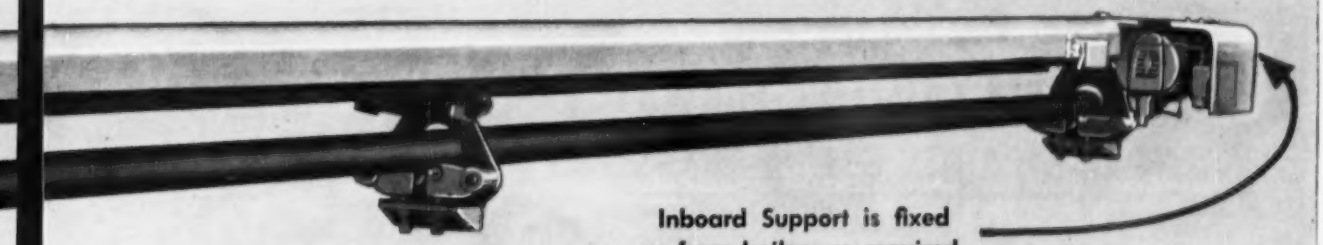
Single Point Outboard Suspension requires no steel at intermediate points.

One of the most popular features of the new Diamond Series 300 IK Long Retracting Blower is the very substantial cover that is formed from steel plate. It is much more than just a cover in the ordinary sense . . . it is also an integral part of the structural backbone of the blower that provides maximum rigidity without excessive weight.

This is only one of many important features (see box on right hand page) of the new Series 300 IK that is establishing a new standard of efficiency, economy and dependability in cleaning those heating surfaces that require a long retracting blower. For further information about the new Series 300 IK, ask the nearest Diamond office for Bulletin 2111AB.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited • Windsor, Ontario

ANOTHER IMPORTANT FEATURE of the NEW Diamond SERIES 300 IK LONG RETRACTING BLOWER



Inboard Support is fixed or from boiler, as required.

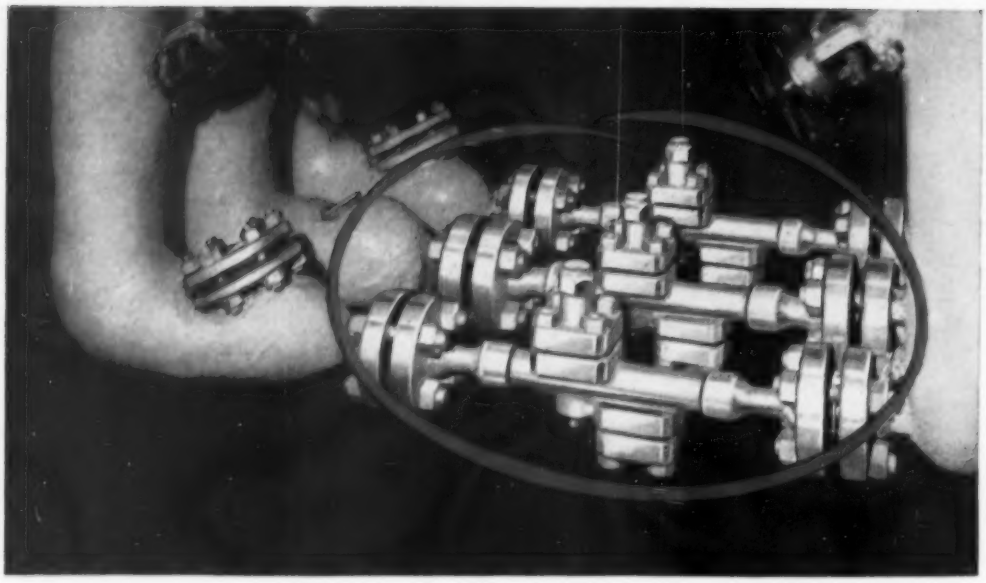
"YOU CLEAN BOILERS BETTER AND AT LOWER COST WITH DIAMOND BLOWERS"

OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

- Front End Single-Motor Drive
- Compact, Accessible Electric or Air Power and Control Terminal Facilities
- Nozzle-Sweep-Every-Inch Cleaning Pattern
- Improved "Type A" Nozzle
- Positive Gear Carriage Drive
- Poppet Valve with Adjustable Pressure Control
- Positive Mechanically Operated Valve
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

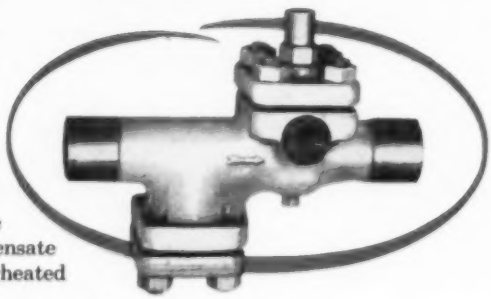
No other blower gives you all these advantages.

7697



Three Yarway Integral-Strainer Impulse Traps draining main steam lines in large mid-west power plant. Other Yarway traps drain extraction lines in same plant. Yarway Integral-Strainer Impulse Traps are available with welding or flanged connections. Pressures 600, 1500 and 2500 psi.

HIGH STEAM PRESSURES AND TEMPERATURES CALL FOR YARWAY INTEGRAL-STRAINER STEAM TRAPS



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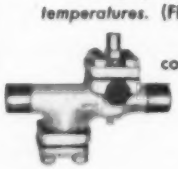

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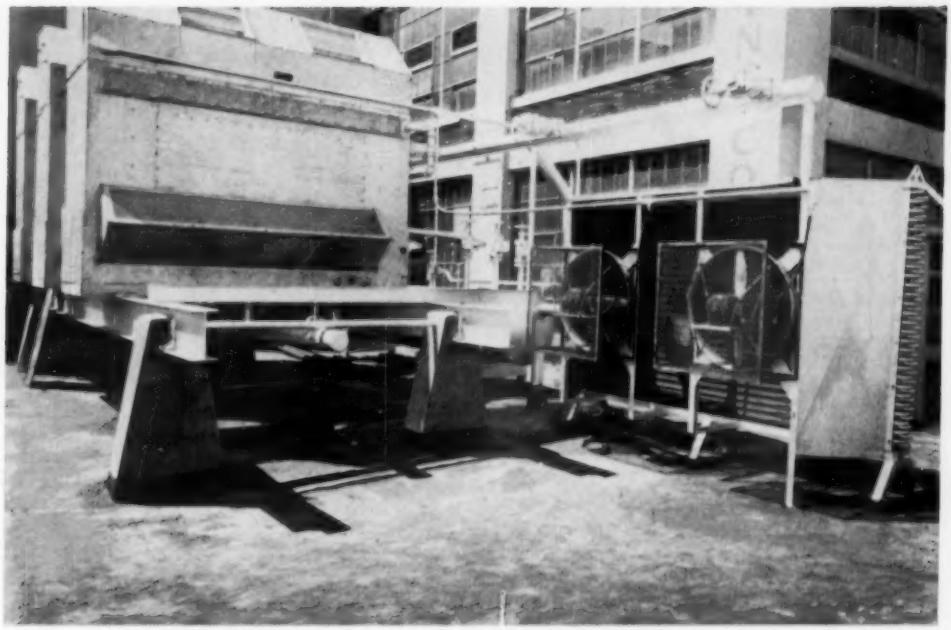


Fig. 1. Evaporative condensers connected to a pre-cooler with two fans (right) each handling 20,000 cfm of air. Warmed moist air discharged at 45-deg angle by fans at top of evaporative condenser. Behind is liquid receiver 30 in. by 16 ft

Keep Your Evaporative Condensers At Top Efficiency

These condensers are most frequently used in refrigeration systems. Here the author gives tips on installing, operating and maintaining them properly. Used right, they save condenser water, cut costs

By TERRY MITCHELL*

SHORTAGES of water and of water drains, in our cities, have directed more and more attention to the merits of refrigerant condensers of the evaporative type. These save about 95 per cent of the water required for other condensers, in which the water is used only once.

This evaporative type, Fig. 1, combines a cooling tower and a condenser in one piece, and is often less expensive to install and operate than separate systems. Here's how it works.

Hot ammonia or Freon gas discharged from the refrigerating machine enters a series of closely-spaced pipe coils in the condenser. These coils are generally made of bare pipe (without fins) and are arranged in rows, Fig. 2, so spaced that they can be cleaned with a brush, in several directions, like rows of corn in a well planted field.

A fan at the top draws a stream of fresh air through these coils, while a rain of water falls over them in the opposite direction. The water is kept in constant circulation, at least while the compressor is operating through the summer months, by a small pump. The water collects in a pan at the bottom of the condenser, where a float valve maintains a predetermined level.

The hot gas is cooled by the combination of fresh, moving air and the evaporation of the water. Remember that one pound of water when evaporating will absorb, in round numbers, 1000 Btu. It is customary practice to circulate one gallon of water per minute over the coils, for each ton of refrigeration capacity. An eliminator is placed between the water sprays and the fan to catch excessive moisture entrained with the air, thus reducing water consumption.

How Condenser Is Built

Tendency now is to make the pipe coils of small size; this saves space, gives better contact with the air and water, and achieves higher internal velocity of the gas. The better velocity increases heat transfer efficiency; results in lowered weight and cost.

The pump is often selected with extra capacity so as to supply cooling water to the jackets of the compressors. In this case, the condenser must also have extra capacity.

Squirrel-cage fans are used on all except the largest condensers, which have propeller-type fans, installed horizontally. The fans should, of course, be balanced, and run in sealed ball bearings. Care must be taken to see that the warm air discharged from the fans is not drawn back into the condenser.

To remove the superheat from the hot gas before it enters the condenser, pre-coolers are sometimes installed, as in Fig. 1. These may be of the shell-and-tube design, cooled with water, or may have finned coils, cooled by the air from a fan. Pre-coolers aid in removing oil from the discharge gas, and may increase the capacity of a condenser by a considerable percentage. However, the heat transfer is relatively poor in the dry tubes.

* Mechanical Engineer, The Frick Co.

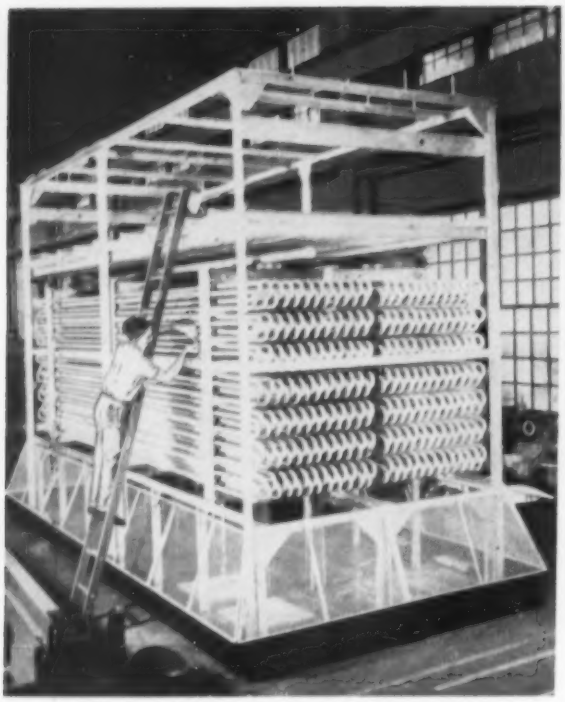


Fig. 2. View of a 300-ton evaporative condenser during shop assembly, showing coils and eliminators as described in text

Fig. 3. Evaporative condenser with by-pass dampers on air outlet, used for heating a dry storage warehouse in winter

Condensers of small and medium size are furnished complete with housings; a recent improvement is to design the housing in three sections, which can be adapted to low headroom or to hanging near the ceiling, if desired. In such a case, the fan may handle only dry air, which it blows into the bottom of the condenser. Larger condensers have the housing assembled after installation. Some of these big fellows will now give capacities as high as 330 tons of refrigeration in one unit.

Allowance should be given, when stating the rating of the condenser, for the foul gas that may be encountered, and for the effect of scale when the water evaporates, which leaves behind its impurities. Over a period of time, the water becomes concentrated with these impurities; one way to overcome this is to bleed off some of the water continuously. Another way is to use chemical treatment.

How to Install

It is wise to allow about 5 deg above the temperature of the liquid ammonia or Freon when figuring the corresponding condensing pressure that may be expected. Condensers with ample pipe surfaces and large fan capacities are always the most economical in the end.

For year-'round operation, it is possible to install automatic controls that will shut off the water, and later the fan, when not needed. Freezing of the water is thus prevented, for the lines are drained. This super-control system, which has been patented, keeps the head pressure uniform, and thus stops either flooding or starving of coolers.

Place the condenser where the liquid refrigerant will drain by gravity into the receiver. Install the condenser as close as possible to the compressor, and to the supply of outside air. Allow space for maintenance. If it is located indoors, ducts must be arranged to carry out of the room the warm humid air discharged from the condenser. Intake ducts may be necessary to bring fresh air to the condenser, if the air in the room should be contaminated with dust, chemicals, or moisture.

Extra-large fan motors should be installed if the ductwork makes any considerable resistance to the flow of air. Air filters on the intake will in some cases be necessary, and in any case a screen should be provided to keep out trash, insects, or birds. Ducts installed indoors may drip unless made water-tight. Access doors are a convenience in maintaining air ducts.

Condensers installed out-of-doors are often exposed to the sun, but the receiver should be shaded or the system may become gas-bound; then the liquid will not flow into the receiver. If the liquid drain connections are too small or contain too many bends, the same thing may result. An equalizing line should be run from the top of the receiver to the top of the condenser. Non-condensable gases should be kept purged from the system. Results will be more uniform if the equipment is carefully leveled.

Operating the Condenser

In making the installation, be sure the proper electric current is brought to the motors on the condensers before trying to start them. Make certain that the fans revolve in the proper direction. Arrange the water supply, overflow and drain lines so that the condenser and pan can be washed out and drained, after the equipment is cleaned.

Set the float valve in the water pan to provide an overflow of about two gallons per hour per ton of refrigerating capacity. See that none of the pipe lines leak either refrigerant or

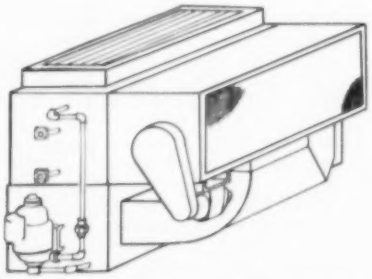


Fig. 4. Evaporative condenser of dry fan type arranged for low visibility on roof of building; or for suspending underneath a ceiling inside the building

water. Fans, pumps and motors must turn freely before the power is applied. Check water strainers and nozzles to see whether they are clean. In testing a new condenser, see whether the high-pressure cut-out is working satisfactorily, as well as that the right head pressure is maintained.

If the surrounding air is at a dry-bulb temperature of 32 F and the water is shut off, the fans will give about 50 per cent of the regular cooling effect. At 20 deg below zero or −20 F, the fans alone will deliver 100 per cent cooling capacity. A separate supply of water to the compressor cylinder jackets will of course be needed in winter, if the water is shut off the condenser.

The water should be tested at regular intervals, if it contains scale-forming salts, fungus growths, chemicals from plant fumes, or salt blown in with ocean air. In any of these cases, the water will require treatment. By sending a sample of the water to the manufacturers of treatment systems, you can obtain recommendations on what to use.

Avoid the mistake of simply throwing the chemicals into the water pan and leaving them to be forgotten. The chemicals must be renewed at the times specified, or the treatment will be ineffective.

Condenser Maintenance

Following maintenance procedure is recommended:

ONCE A WEEK

Oil all moving parts, according to instructions.
Check the flow of water through the spray nozzles, and clean if necessary.
Clean the screen on the suction of the water pump.
Check the V-belts driving the fans for tension and wear.
Remove deposits from the water pan, and flush clean.
Purge non-condensable gases from the system, preferably at the receiver.
Clean or replace air filters in the intake, where used.

ONCE EVERY SEASON

Check operation of float valve, and clean if necessary.
Look for corroded spots; after removing rust, coat with zinc chromate primer and aluminum-bronze paint.
Check condition of fans and fan bearings. Watch for tell-tale vibration. (Stainless-steel fans and shafts can be supplied where necessary.)
Clean scale or slime from the coils with a wire brush.
If cold weather is approaching, drain the water lines and pump, to protect from freezing.
Repeat weekly procedure given above.

If you are in charge of some evaporative condensers and must find a way to make them carry an overload, try to insert a pre-cooler in the discharge line from the compressors. Or, sub-cool the liquid refrigerant. Check the condenser housing for gaps which by-pass air around the coils. Wire-brush the coils as often as necessary to keep them clean.

Be sure the pipes are all wetted, throughout their length. Speed up the fans, but watch that motors do not overheat. Temporarily removing the eliminators may increase the flow of air without depositing scale on the fan blades (and throwing them out of balance). Supply the driest, coolest air available, to the bottom of the condensers.

Use only cold water for make-up. If you suspect gas-binding, install equalizing lines. Purge out foul gases frequently, or use an automatic purger. Place an awning or roof over the condensers to protect them from the sun; make sure this does not restrict the discharge of air. Check the sizes of the pipe lines and headers; auxiliary pipes may be welded in to advantage, if the head pressure is unreasonably high.

Water sprayed over pre-coolers, oil separators and long hot-gas lines will remove a surprising amount of heat, during an emergency. Call in an experienced refrigerating engineer, to get recommendations; other parts of the system may also need attention. And as soon as possible, install more condensers!

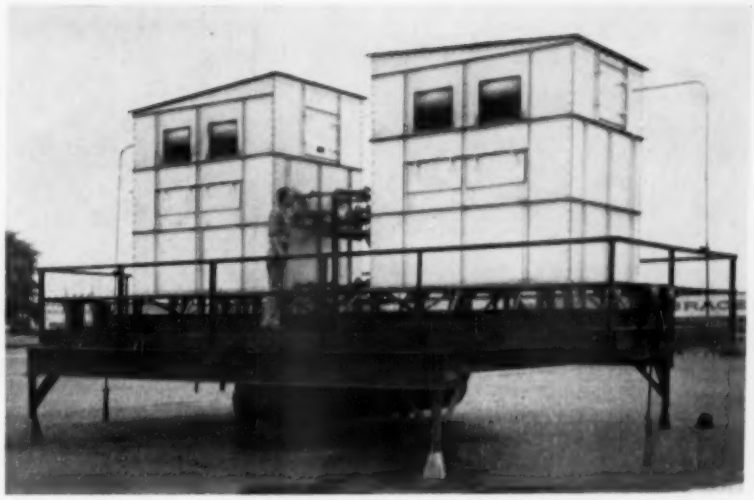


Fig. 5. Two large evaporative condensers, with built-up metal housings, supported by steel framework above ammonia liquid receiver, which is shown under platform

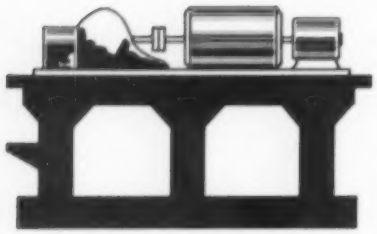
Hydro Turbines Rebuilt to Increase Output by 20 Per Cent

TURBINE-REBUILDING order, valued at a quarter of a million dollars, was recently awarded to the S. Morgan Smith Co, by the city of Seattle, Wash. The contract calls for increasing the power output of three 37,000-hp vertical Smith-Francis turbines to 45,000 hp each under a 325-ft head at 257 rpm. Included in the order are three new steel runners with new wicket gates, discharge rings and miscellaneous operating mechanism parts. The turbines involved are three units of the Gorge Plant of the city of Seattle. Delivery will be spaced during the first half of 1958.

The original turbine installations were made in 1922 and 1923 for 27,500 hp under a rated head of 275 ft. The original designs allowed for an increase to 37,000 hp under a future rated head of 325 ft. Because the ultimate maximum head was expected to rise as high as 375 ft, the original generators were purchased for a maximum potential output in excess of 37,000 hp. Recent power shortages in the Washington area have made it necessary to increase the plant output. Construction has already started to increase the height of the dam.

Extensive model tests in the new high head test stand at the S. Morgan Smith laboratory proved the feasibility of increasing the existing turbine output by more than 20 per cent; full generator capacity may be obtained with the new rated head, with only limited modifications to the original design. The new runner and gate design not only provides the increased power with little loss in efficiency, but has improved cavitation characteristics to permit maintaining the original setting above tailwater elevation.

These research results indicate that substantial economies will be possible on many new and some existing installations with higher turbine speeds and settings, as well as smaller spiral cases and inlet valves.



Good Turbine Foundations Prevent Maintenance Headaches

By R. B. DODDS*

NEITHER a house nor a turbine generator are any better than their foundation. Many a maintenance headache can be prevented if the purchaser of a turbine generator will make sure his unit will be on a firm foundation which is compatible with the operating characteristics of his particular machine.

General: Try to have the foundation independent of the building and independent of all other foundations. It is not easy to predetermine the factors affecting natural frequencies of vibration. Remember, the greater the foundation mass, the smoother the operation.

Openings should be provided in the foundation for necessary piping plus insulation. Conduit should be placed in the foundation for running main field leads, and exciter field leads.

Loading: Allowable loads on the foundation are to a great extent based on previous design and past experience. They are intended to give reasonable rigidity to the structure. Vertical loads are usually shown on the turbine-generator outline drawings. They include weights of the turbine, generator and loading due to the condenser.

To insure rigidity and stability of the foundation, the lateral load should be figured as 25 per cent of the weight of the turbine and generator, applied at the centerline of the unit. The longitudinal load should be figured as 10 per cent of the weight of the turbine and generator, applied at the centerline of the unit. The normal torque may be calculated from the speed and rating.

Due to the effect of the inertia of the stationary parts, a large percentage of the short-circuit torque is not transmitted to the foundation; therefore, foundation loading calculations may be based on five times the normal torque (although maximum short circuit torque may be 20 times normal torque).

The vertical deflections and deformations of beams and columns should not exceed 0.020 in. This is a *rule of thumb* and provides a maximum practical stiffness so that the turbine generator can be given a satisfactory alignment without entering the zone of possible resonant vibration. To guard against resonance, deflections should not be close to the values of resonant deflection given in the following table:

Rpm	Resonant Deflection (Inches)
1200	0.025
1500	0.015
1800	0.011
3000	0.004
3600	0.0028

It is apparent that even the stated maximum allowable deflection of 0.020 in. is questionable in machines running below 1500 rpm. The columns should be designed for equal shrinkage allowance insofar as possible. Care should be exercised in allowing for unequal temperatures due to proximity of steam lines.

Foundation Mat: The foundation superstructure must have a base of ample proportions to support it. The character of the sub-soil (see POE, December, 1956) is a factor in determining the construction of this base and it is not possible to give any set rules for construction. The mat should be of sufficient thickness and amply reinforced to provide a strong, stiff support. A thickness of at least 24 in. is recommended for units up to 7500-kw rating.

Safe soil loading under the foundation mat may vary from 1 to 25 tons per sq ft, depending on the type of soil. Allowable loadings should not exceed ¼ of the safe load, and never should exceed 15 tons per sq ft, which is considered the safe crushing strength of concrete.

Foundation Walls: Solid walls with only such openings as necessary provide more rigidity than columns. Walls and columns over 12 ft in height should have a batter of 1 in. to the foot. Under 12 ft the batter may be less. The height of the foundation should not exceed twice the width at the base. Walls or columns should have a thickness at the turbine deck of at least 14 in. for units over 1000-kw rating. On units less than 1000 kw, 12 in. is sufficient.

Reinforcing rods should be located in walls and columns in accordance with good design practice, suitably tied in to the base. They should be at least 1½ in. from the wall surface to protect the steel from temperature changes. Cross bracing should be provided between the walls or columns near the top of the foundation for lateral stability. Cantilever construction should be avoided. When cantilever construction is necessary, it should have sufficient bracket supports to provide a stiff structure.

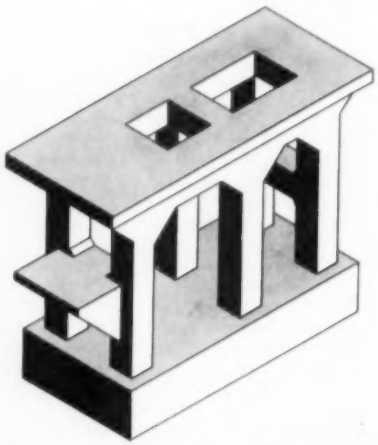


Fig. 1. Isometric of a well-designed concrete turbine-generator foundation

Turbine Deck: Openings in the deck under the turbine and generator should agree with openings required on the outline drawing for air cooler, wiring, and piping (including an allowance for insulation on steam pipes). The minimum thickness of the deck should range from 14 in. for 1000-kw units to 24 in. for 7500-kw units.

* Assistant Manager of Service, Worthington Corporation.

Steel Foundations: The use of steel foundations has been found to be practical when space is limited. They are easy to construct, and welding makes it possible to easily take care of intricate details. Due to the flexibility of steel foundations, it is necessary to use heavy sections to reduce deflections. This results in unit stresses which in common practice would be considered very low.

Steel structures have no vibration damping properties and tend to amplify any vibration and noise. For this reason and also to provide a good surface to support the machine, a concrete deck should be poured of sufficient thickness to provide a relatively stiff mat. Cantilever beams should be avoided whenever possible. In cases where they must be used, they should be supported with gusset plates and stiffeners.

Beam and channel flanges under load should be fitted with stiffeners. Steel columns should be well braced especially at the mid-point. It may be necessary to install bracing after the equipment has been installed. The web of columns should be transverse to the longitudinal centerline of the unit.

Where possible, the foundation should be stiffened horizontally with cross bracing and gusset plates at all corners. A concrete mat will help to provide this stiffness. The horizontal supports under bearing pedestals should be of built-up sections, properly stiffened to prevent longitudinal vibration. Steel foundations may be encased in concrete for protection and added rigidity. Concrete should cover the steel to a depth of two to three inches.

Good Design Practices: Regardless of the type of structure, minimizing resonant vibration is a practical matter. Following these rules normally results in a satisfactory foundation:

1. Provide a stiff structure, primarily for alignment purposes.

2. Use a type of construction that will facilitate the best possible original and permanent alignment, bearing in mind that the machines are installed with an accuracy of better than 0.001 in. This rule applies to everything from the substructure to the grouting of the machine base.

3. Use a material that has mass and internal damping properties. If a *live* material (bare steel) is used, concrete filling is advisable, also a concrete covering for the deck, which should be as thick and self-supporting as practicable. Resonance calculations are especially advisable for all members of such a structure. Scrutinize all structural details. Take all possible precautions against misalignment from temperature variations. Be prepared to encase, dampen, or in some way *tune out* any elements that may vibrate in spite of precautions.

4. Whatever the class of construction, eliminate so far as practicable all brackets, cantilevers and projections. If their use is necessary, make them rigid. They usually result in magnification of vibration amplitude even though not definitely resonant. Make unsymmetrical or eccentrically loaded beams as massive as practicable. Investigate the resonant properties of any floors, and thicken or rib them if necessary.

5. When steel gratings or floor plates are used, mount them on soft rubber cushions or the equivalent. These steel floors are almost invariably lively.

6. Segregate the station operating floor completely at the turbine level. If this is not practicable, break all *moment* continuity between the floor and the foundation.

7. Any metal ducts or similar construction should be viewed with suspicion. Calculate their periods of vibration and be prepared to use additional stiffening if they vibrate excessively. Better yet, segregate them.

8. On completion of the job, make a speed-vibration survey of the assembled installation.

Foundation Mass: A rule of thumb for calculating the foundation mass with rotating machinery calls for using 3 times the unit mass. Normally a turbine-generator manufacturer will not assume responsibility for the design of a customer's foundation. However, the customer and manufacturer can mutually benefit if the foundation drawings are sent to the manufacturer for inspection and comment. In this way the customer may benefit from the years of experience gained by the manufacturer.

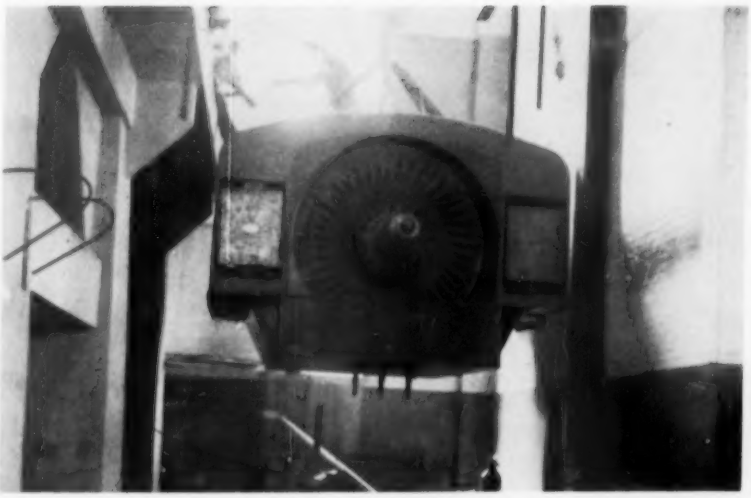


Fig. 3. The heavy lift in close places. Here a 51-ton generator stator and rotor are being lifted by crane to the top of the concrete foundation shown at the left

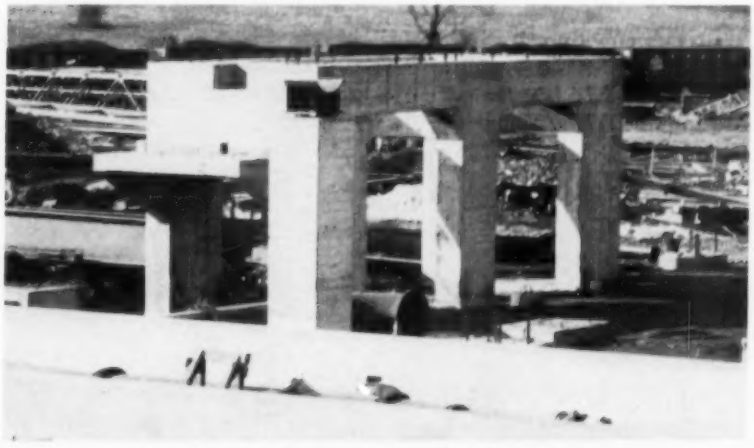


Fig. 2. Typical foundation under construction for 12,500-kw turbine generator

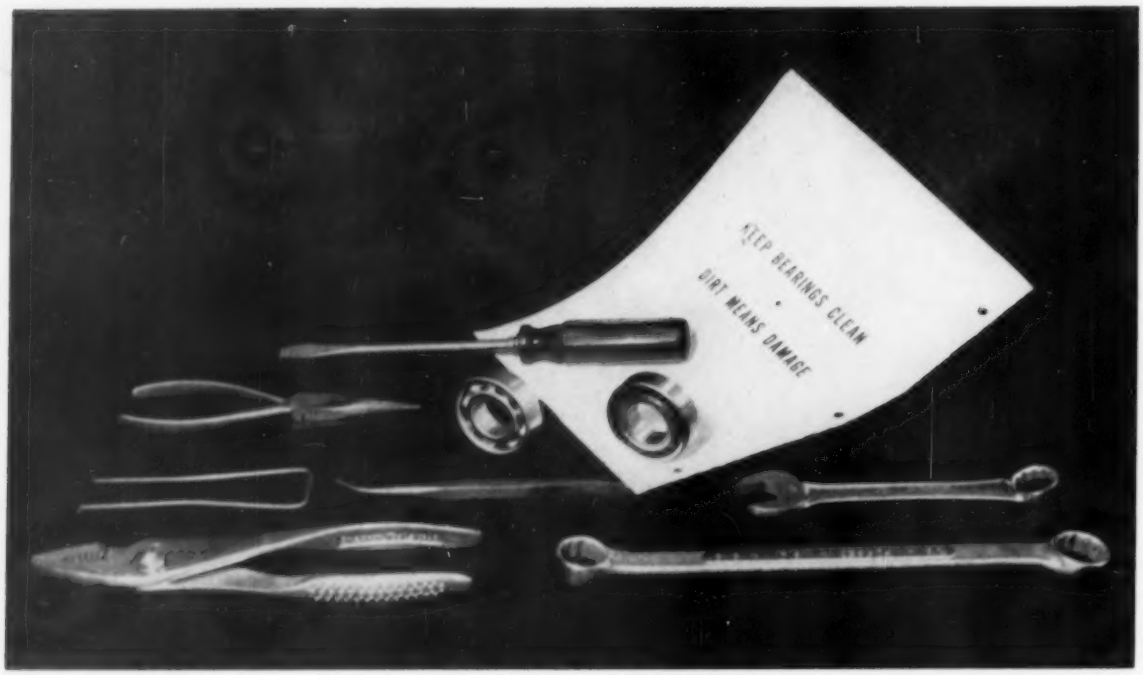


Fig. 1. Key word in care and maintenance of ball and roller bearings is cleanliness. Everything that comes in contact with bearings—tools, hands, bench, surroundings—must be equally clean. Remember, one chip can destroy a bearing

How To Service Ball and Roller Bearings . . . . Part I—Effects of Design

If ball and roller bearings are properly lubricated and serviced, wear and deterioration of these rugged machine components become almost negligible factors in equipment maintenance. Most anti-friction bearing trouble can be traced to a few easily preventable causes—each the result of mistaken lubrication or service procedure. In this article, author tells how and why of right method

By E. P. STAHL *

IT IS THE PURPOSE of these articles to cover some points of preventive and operational maintenance of ball and roller bearings that will help maintenance men keep anti-friction-bearing-equipped machines operating efficiently with a minimum of attention and down time.

Design and construction of modern equipment are such that bearing trouble today is seldom the result of faulty or inadequate engineering or manufacturing techniques.

When anti-friction bearing failure does occur, the cause can almost always be traced to one or more of the following reasons:

1. Dirt or foreign matter in bearing.
2. Improper lubrication.
3. Damage to bearing during disassembly for repair.
4. Improper reassembly after repair.
5. Improper handling of bearings prior to reassembly.

All of these factors in bearing life are under the control of the men who maintain and service the equipment; the more they know about anti-friction bearings and the consequences of mistreating these precision-built devices, the less likely it is that premature failure will shorten their useful life.

Those features of design and construction which affect anti-friction bearing maintenance will be discussed briefly. One of the most significant is housing design.

Of particular importance is uniformity and roundness of the bearing housing bore. If the housing section is too thin, it will tend to distort at the thin spot. Also, the housing should be thick enough so that bolt holes are not too close to the bore.

Whenever practicable the bearing housings should be equipped with lip-type seals as illustrated in Figs. 6 and 7 (or similar) to retain lubricant in the bearings and exclude foreign matter. Figure 6 is equipped with a finger spring, Figure 7 with a garter spring.

It is well to note at this point that housings equipped with these tight seals can build up pressure and prevent grease from entering the bearing unless properly vented. One method to accomplish this is to equip the housing with a pressure relief fitting as illustrated in Fig. 9. With a device of this kind, the maintenance men know the moment a ball or roller bearing has enough grease. When back pressure in the bearing reaches $2\frac{1}{2}$ oz per sq in., excess lubricant escapes through the vent ports, thus indicating that the bearing is sufficiently lubricated.

Another way to vent bearing hous-

*The Garlock Packing Co., Palmyra, N. Y.

ings is to equip them with unit or lip seals mounted with the sealing lips pointed outward, opposite as shown. This arrangement allows grease to escape under the heels of the seals, thus relieving internal pressure.

Two ball or roller bearings well spaced in a housing with only one grease fitting outside a bearing are apt to be inadequately lubricated. Lubricating such an application is like blowing in a bottle. The answer to this problem is to provide a second grease fitting near the second bearing.

At this point it seems appropriate to discuss the handling and installation of bearings. Even though ball and roller bearings are rugged devices, they must be handled carefully and installed properly to give a full measure of service.

Bearing Enemy No. 1

Dirt is, without question, bearing enemy number one. For this reason maintenance men should take every precaution in handling bearings from the receiving room to assembly to insure that no dirt or foreign matter is allowed to get into them. In order to guard against the possibility of dirt entering bearings, users of ball and roller bearings should be cautioned against breaking box seals or wrappings before delivering bearings to the stock room or assembly job. This is a precautionary or preventive measure that must be followed rigidly.

The stock room foreman should check all bearings delivered to him by the receiving department. First, he should make sure that every box or wrapping is sealed. In case the seal has been broken, the top lid should be removed to see if the waxed paper in which the bearing is wrapped is broken or shows signs of having been opened. Determine if the seal was broken due to rough handling in transit or in unpacking. If it appears the seal was broken due to carelessness, the box or package should be resealed with a piece of gummed tape, if it is certain that no dust or dirt could possibly have reached the bearing. If the bearing box is badly mutilated and the wax paper torn, the bearing should not be put in stock until it has been carefully inspected to determine whether dirt could have found its way into the grease in which the bearing is packed. If it is necessary to wash the bearing, it should be done according to instructions to be given in a following section of this article.

Another precautionary or preventive measure is to store ball and roller bearings in a cool, dry place; cool, in order that the packing grease will not melt and drain to the lower part of the bearing; dry, in order to prevent moisture from penetrating to the bearing surface and causing rust.

Maintenance and shop men must bear in mind that practically all dirt and dust cause wear. These destructive agents are always present to get into ball and roller bearings and machines to destroy accuracy and shorten life.

Dirt Is Everywhere

It is not always the obvious kind of dirt that may cause the most harm. In every factory or mill, even though clean to the eye, there is dust present. It is very often of an insidious, nearly invisible kind. This dust settles in lubricants, exposed machine parts, and bearings if they are not thoroughly protected.

It is during the assembly operation that bearings and bearing parts especially may be exposed to contamination by dirt, and if this does occur, their service life is bound to be materially shortened. Whether in the store room, on the assembly bench, or in the machine itself, every precaution should be taken to protect ball and roller bearings from dirt and contamination. Such protection will pay big dividends in the long run. It

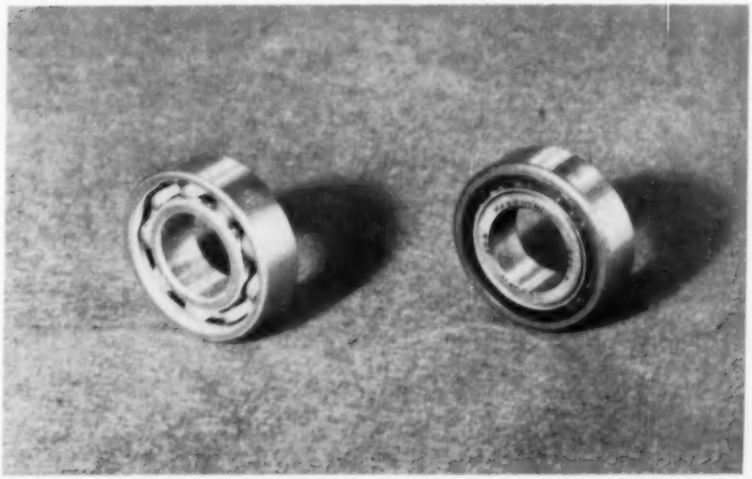


Fig. 2. Two common anti-friction bearings in wide use: at left, unshielded ball bearing—right, a plain roller bearing of same size. Many other types are used

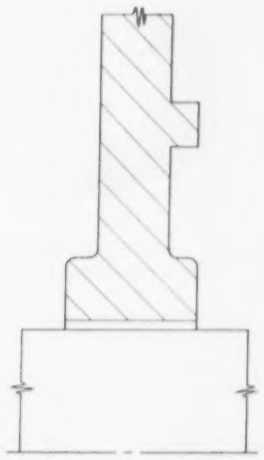


Fig. 3. Diagram of plain seal for ball, roller bearings. The clearance is closely controlled

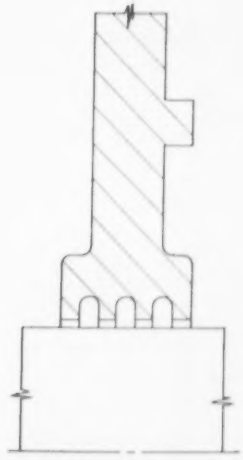


Fig. 4. Capillary grease seal; similar to the plain type seal

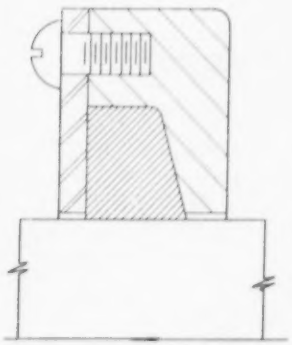


Fig. 5. Another type of seal; felt retainer can be removed

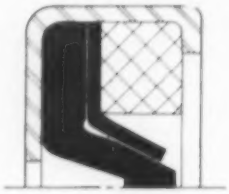


Fig. 6. Synthetic rubber unit type seal; a widely-used type

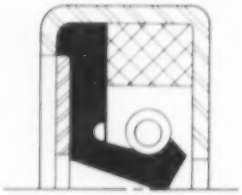


Fig. 7. Similar to preceding type; this uses garter spring

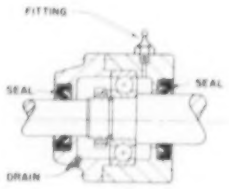


Fig. 8. The standard bearing mount for grease lubrication

is far better to spend pennies for bearing cleanliness than to spend dollars for bearing maintenance and replacement. All parts of the bearing assembly, including shafts, housings, lock nuts, spacers, etc., should be thoroughly clean before installation. This also applies to assembly benches, assembly tools, and lubrication fittings. Bearings as received should be stored in a cool, dry place and arrangements made to use the older bearings first.

If bearings are left exposed after mounting they should be masked — covered with a clean cloth or piece of paper. Normally it is not necessary to remove the protective coating on the bearings as received, since this material has considerable lubricating value. However, if the bearings are to be used at extremely low temperatures, it may be desirable to remove the protective coating and add an extreme low temperature lubricant.

Support Bearing Properly

Shafts should be cleared of all dirt and chips, and burrs should be removed before assembling bearings. The shaft should then be oiled so that the inner bearing ring may be mounted more readily; care should be taken to see that the bearing is started squarely on the shaft to avoid any possibility of scoring the shaft seat. Pressure should always be exerted against the inner ring — *never against the outer ring.* This is extremely important as the balls or rollers may indent the raceways causing roughness and premature failure of the bearings.

If an arbor press is used to install the bearing, a length of relatively soft steel tubing, fitting closely around the shaft, should be used. The shaft should be supported as near to the bearing as possible, and in case of long, small-diameter shafts, care should be taken to avoid springing the shaft during the press-fitting operation. If an occasional single-bearing is to be applied, and an arbor press is not available, the inner bearing ring may be tapped on to the shaft using a short length of tubing and a hammer.

A hammer should not be used directly on a bearing under any circumstances other than an emergency. It requires very skillful handling to avoid trouble in this type of assembly.

In installing ball or roller bearings, a lead, babbitt, or wooden hammer should never be used as chips are apt to come off and fall in the bearing. Extreme care is necessary to avoid hitting the ball or roller cage. It is best to use a soft steel or malleable iron pipe that will not chip; be sure it seats well against the inner bearing ring or race. When using a pipe driver for installing large bearings, it is best to have two people tapping on each side. Otherwise, it is almost impossible to avoid tilting the inner ring or race.

Large-sized ball and roller bearings are sometimes given a shrink fit on the shaft. When this is done, the bearing should first be heated in an oil bath to a temperature not exceeding 250 F. Use a screen or rack to prevent the bearing from contacting the bottom of the container. When a number of large bearings are to be applied, infra-red lamps and reflectors may be used for heating them. After the bearings have reached the proper temperature, the inner ring or race should be slipped over the shaft and held against the shaft shoulder until cooled. When the bearing has been firmly seated on the shaft, it should be checked to see if it rotates freely and has the proper internal clearance.

Guard Against Scoring

When installing ball and roller bearings in bearing housings, care should be taken to start the bearings squarely in the housing bore to guard against shaft scoring. Excessive pressure should not be exerted on the bearing at any time. Where single row angular ball bearings and tapered roller bearings are mounted in an "opposed" set up, it is important that the final assembly be checked to insure that there is a free axial movement in the bearings. If the bearings are set up too tight they will fail prematurely.

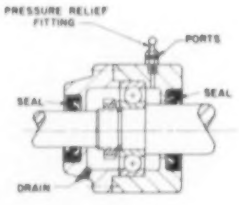


Fig. 9. Same as Fig. 10, but has a pressure relief fitting

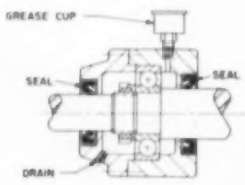


Fig. 10. A simple grease cup can be utilized for light duty

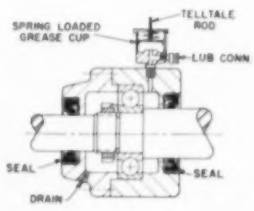


Fig. 11. Spring-loaded grease cup has a tell-tale indicator

At this point seals and sealing should be discussed. No matter how well ball and roller bearings are selected, mounted, and lubricated they will not give a full measure of service unless protected with good seals. It is good economy to use new seals to save dollars in bearing maintenance and replacement.

The biggest single cause of rejected ball and roller bearings is unquestionably dirt. It is the first thing inspectors look for when a ball or roller bearing comes back to a bearing plant, and in probably two out of every three cases it is the reason a rejected bearing feels rough or has failed. Dirt is enemy number one of ball and roller bearings. It is a major problem. Few maintenance and shopmen appreciate how very important bearing cleanliness is.

Two Factors in Cleanliness

There are two factors that are basic in keeping bearings clean: The mechanics of keeping them clean in the handling and installation processes in the plant, and the mechanics of keeping them clean in the field under actual operating conditions. The matter of keeping bearings clean in the field is the function of seals and sealing.

Thousands of dollars have been invested by ball and roller bearing manufacturers in elaborate equipment to clean bearings. Power washing machines, clarifiers, stills, centrifugal extractors, and blowers compose part of such machinery. Wrapping and packaging are done in airconditioned rooms. Only packing greases of highest quality especially refined under conditions of great cleanliness are used. These are the precautions taken by bearing manufacturers to make sure the bearings are delivered to the bearing user clean. Carelessness in handling and in the assembly room can destroy in a few seconds these protective measures of the manufacturers and shorten the life of the bearings. It pays the bearing user to be careful — it pays to do everything possible to keep bearings clean and so prevent the abrasive action that dirt causes in a bearing.

It is estimated that the majority of ball and roller bearings fail due to worn rolling elements and raceways resulting from foreign matter entering the bearing and mixing with the lubricant to form a cutting compound. The best bearing made will fail prematurely unless protected by good seals.

Types of Seals

A number of different forms of seals are available to keep lubricant in bearings and to exclude foreign matter. A few of the popular ones are shown in the illustrations. Depending upon the severity of the sealing problem and the type of conditions under which the bearing operates, these vary from simple plain and grease groove seals to the more elaborate synthetic rubber and leather unit or lip-type seals.

Figure 4 illustrates the simple grease groove clearance seal used for low and medium speed where relatively heavy lubricants are used. Figure 5 illustrates a renewable felt seal held in an annular groove in a bearing end cover with a retaining plate. This is recommended for relatively clean and dry applications for low and moderate speeds.

Figures 6 and 7 illustrate the synthetic rubber and leather unit or lip type seals used extensively in the automotive and tractor and farm machinery industries. Unlike the previous seals illustrated, these seals are designed for a press fit in a seal recess or housing bore. The unitary construction and relatively low cost of these seals is responsible for their wide use in industry. In addition to the primary seals illustrated and described here, seals are often given an assist by an auxiliary member such as a metal slinger or shroud where there is a large amount of dirt or water present in the seal area.

There is an old saying that "an ounce of prevention is worth a pound of cure.' This applies particularly to bearing maintenance. Pennies spent on preventive maintenance will save dollars in operational maintenance.

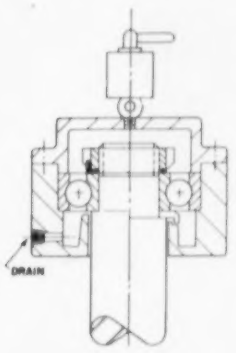


Fig. 14. Vertical mount with sight-feed oil cup shows drip

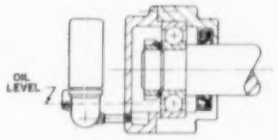


Fig. 15. A constant-level oil feed to the horizontal bearing

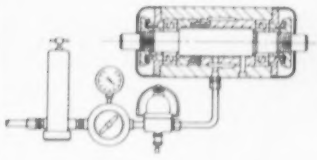


Fig. 16. Oil-spray lube feed to high-speed spindle bearings

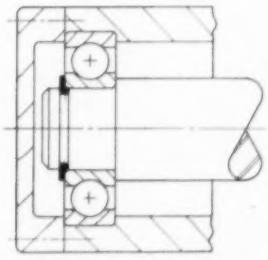


Fig. 12. This type of bearing gets grease from machine

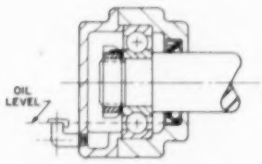


Fig. 13. The standard bearing mounting using oil lubrication

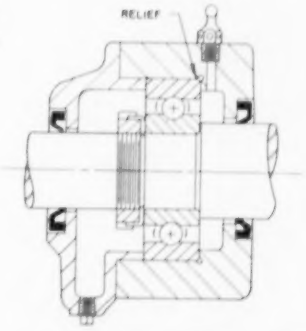
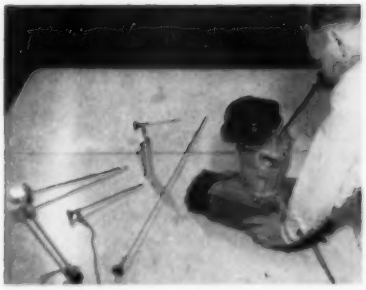


Fig. 17. Ball bearing housing drawing shows relief at corner

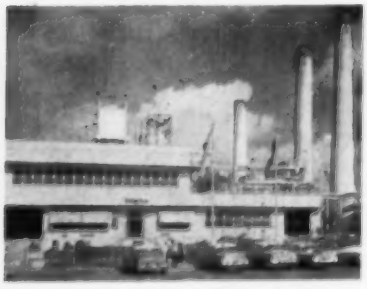
Newest hydro station in New England is now completed on Connecticut river at Littleton, New Hampshire. Named in honor of Samuel C. Moore, one of founders of New England Electric System, new station is last link in harnessing of Fifteen Miles Falls. Together with two other hydro plants on this stretch of river, 150,000-kw Samuel C. Moore station will help develop capacity of 310,000 kw from total river fall of 367 ft. Moore station will be peak load plant

POWER ENGINEERING'S NEWS REEL

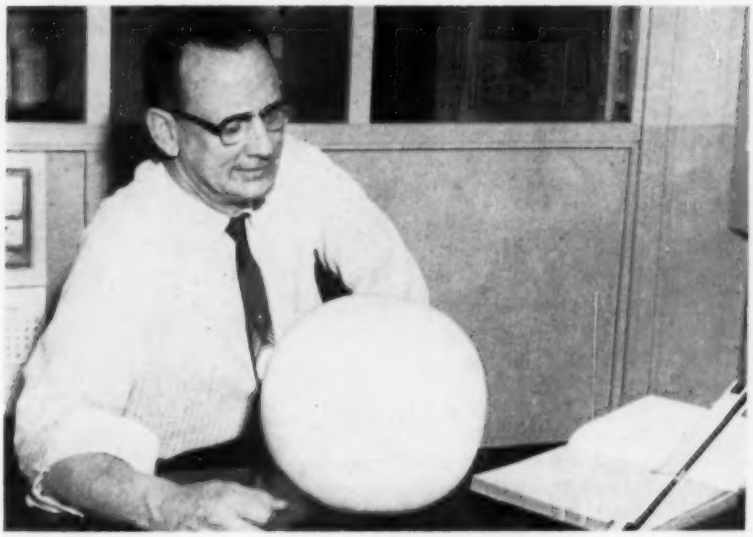
Heavyweight in generating equipment is this 228-ton stator arriving at Will County Station of Commonwealth Edison system. Heaviest piece of generating equipment ever to arrive in Chicago area, GE-built stator is part of 260,000-kw unit scheduled to go into service at ComEd station between Lockport and Lemont



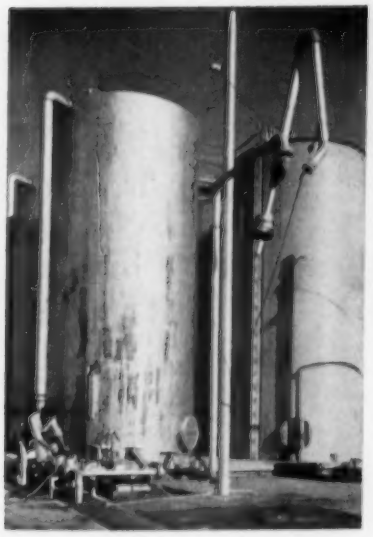
Looking for something? You can probably find it with these borescopes. Made by National Elec. Instrument Co, they help you look where you can't see



Power for Puerto Rico gets boost from new addition to San Juan station. P. R. Water Resources Authority has grown steadily since its start in 1950

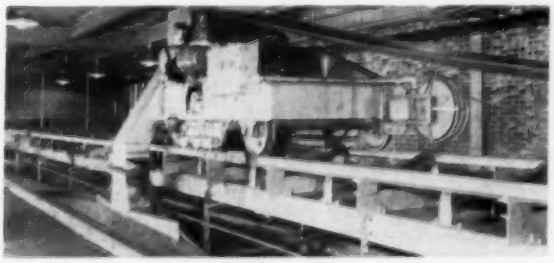


Somebody laid an egg! . . . Any suggestions? If you have any ideas about a practical use for this 10-in. aluminum oxide heat exchanger sphere, Norton Co, its maker, will be glad to hear from you. Ordered by customer in research work, somebody goofed in making out order; specified 10-in. instead of 1.0 in.

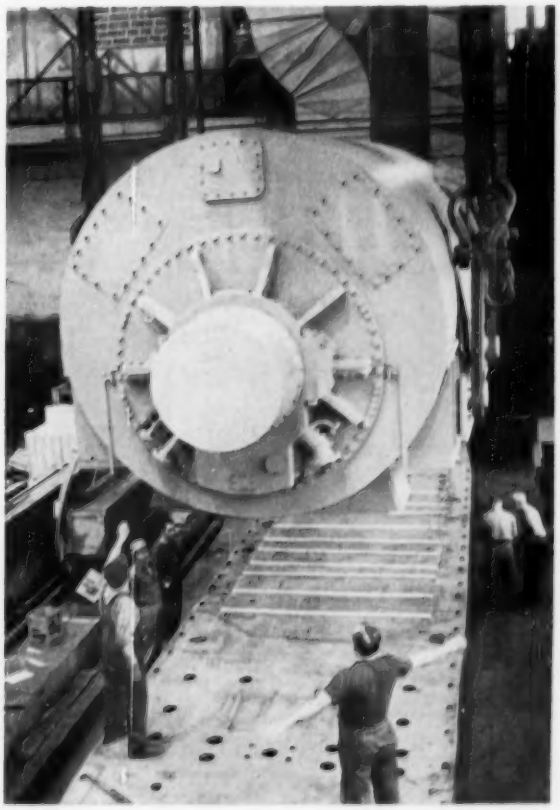


All aluminum piping installation made for Du Pont by the Alex Robertson Co on West Coast to store polyvinyl emulsion. The tanks are also aluminum

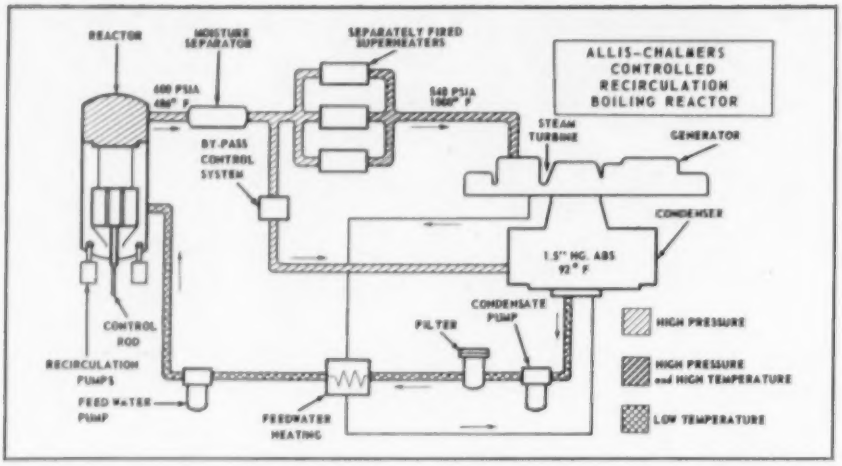
Out of the water first time in 20 years, wrought iron trash rack at hydro station of Fort Peck Dam in Montana gets inspection and cleaning. After cleaning with pressure water spray, rack—one of 45—went back into service



Exposed trolley wire hazards are eliminated by automatic take-up reel on this Link-Belt coal tripper. Shown at right in photograph, Gleason reel pays out and retrieves power cable as tripper travels over length of conveyor belt



100,000-kw generator for atomic power plant at Shippingport, Penna., is prepared for shipment at East Pittsburgh plant of Westinghouse Electric. Weighing 202 tons, unit measures 29 feet in length, will be installed outdoors



Flow diagram of the Allis-Chalmers Controlled Recirculation Boiling Water Reactor system

Announcement of this proposed atomic power plant brings to 19 the number of atomic power plants presently planned to be built in the U. S. at an estimated cost of $675,000,000. Total capability of these plants will be around 1,500,000 kw

Northern States Power Co Plans 60,000-kw Nuclear Plant

PLANS for the construction of a full-scale atomic power plant of new design were announced recently by the Northern States Power Co, one of a group of participating Midwest electric utility companies. Plans call for a 60,000-kw plant estimated to cost about $20,000,000 to $25,000,000 to be completed by 1962.

Subject to the approval of the Atomic Energy Commission, the plant will be located within the system of Northern States Power Co, which company will own and operate the plant. Major interconnections between companies will permit energy produced by atomic power to flow into the systems of the participating companies. Pioneer Service & Engineering Co will act as architect-engineer on the project, and Allis-Chalmers Mfg Co will build the power generating equipment.

The reactor for this plant will be a new type of boiling water reactor — a Controlled Recirculation Boiling Reactor (CRBR). An outstanding feature of this type of boiling water reactor is its high energy output per unit of volume. The cylindrical core, measuring 5 by 5 ft, will generate as much heat — 133 mw — as a boiler burning some 20 tons per hr of coal continuously. This is possible because of the large volume of water being recirculated through the reactor.

This boiling water reactor differs somewhat from the boiling water reactor used as the power source for the 5000-kw power plant now operating on full power at Argonne National Laboratory in that means will be provided to recirculate the water through the reactor by recirculation pumps. Allis-Chalmers has had this type of reactor under study for some time.

Another feature of this plant which makes it not a true nuclear power plant is the fact that it incorporates a separately fired superheater. After the steam is produced in the nuclear reactor at a temperature of 488 F, it passes through superheaters fired with coal or oil. This will increase the temperature of the steam to 1000 F for use in the turbine. While the use of such conventional fuel fired superheaters will increase the steam temperature it detracts somewhat from the ideal conception of a power plant without stacks or smoke or conventional fuel. It will be something of a hybrid.

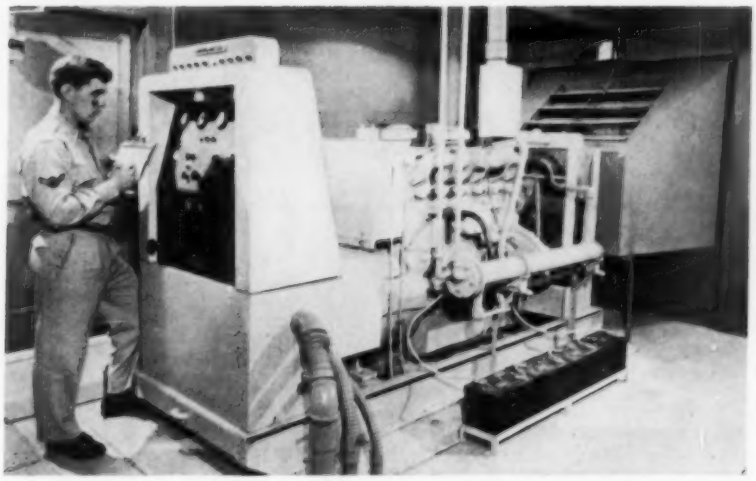
As planned at the present time, the nuclear reactor will supply 133 mw of heat and the superheaters 38 mw, giving the plant a thermal capacity of 171 mw. Steam will be generated in the reactor at a pressure of 600 psi. There will be a slight drop in this pressure through the superheaters so that the steam will be delivered to the turbine at 540 psi and 1000 F.

The steam turbine will be similar to the one used in the Argonne plant but it will be much larger — 60,000 kw.

The slightly radioactive steam flowing through the turbine will be sealed in by special seals on the turbine shaft.

The reactor vessel will be 9 ft in diameter and will be 23 ft high. It will be installed in a steel and concrete building approximately 45 ft in diameter and 70 high. The turbine generator unit will be installed in a conventional type building.

Of particular interest is the control system. The reactor power will be regulated by controlling the rate of water recirculation through the reactor core. This will be accomplished by large pumps located at the bottom of the reactor as indicated in the accompanying diagram. If greater steam output is desired, the speed of the recirculating pumps will be increased by automatic control. This will force out additional steam from the reactor core, causing the power to increase to a new level. If the demand decreases, the pumps will slow down and thereby reduce the reaction rate. The feedwater will have a temperature of 325 F and the total steam flow will be some 502,000 lb per hr.



Only job for attendant of automatic diesel power plant is to read instruments

Need An Educated Power Plant? This One Thinks for Itself

IN THESE DAYS OF machines that forecast elections, solve equations, identify criminals, or make up the payroll, we find it pretty difficult to get excited about announcements of new electronic marvels just because they do something automatically. Nowadays, even automobile seats remember your favorite sitting position and adjust themselves accordingly.

Nevertheless, our editorial eyebrows were lifted by a recent announcement from Consolidated Diesel Electric Corp about their new automatic diesel power plant. This unit features an electric "brain" and built-in memory system. The manufacturer says it ". . . thinks for itself, turns itself on and off, sends signals about operating conditions to technicians in a control center miles away and operates without manpower in attendance . . ."

These package power plants were designed for gap-filler radar stations, which fill in between main and auxiliary radar stations in our defense system. Delivery is now being made to the Department of Defense. The plants will stand in reserve or be used as a source of auxiliiary power in regular operation.

Normally, the units will be paired. If normal power supply fails, weakens, fluctuates, or otherwise ceases to supply steady and sufficient power for radar operation, the automatic power plant turns itself on and provides electric power for the full load in less than 12 seconds.

If one diesel generator set ceases to operate at full capacity or fails because of, for example, insufficient lubricating oil — or any other malfunction — the second unit automatically turns itself on and assumes the load.

At the same time, the inoperative unit returns itself to the standby position, turns itself off, and relays back to the main control plant that it has failed and the reason for the failure. The memory system indicates to technicians at the control point what repairs are necessary and what parts need adjustment or replacement.

Here are some other examples of their educated performance:

1. The unit disconnects the load from commercial power supply before taking over. This prevents damaging equipment or feeding power from the unit into commercial power lines.

2. When commercial power fails, both diesel generator sets start simultaneously.

3. First unit to reach full power output sends a signal to the second unit; second unit then turns itself off and returns to standby condition, ready to take over in case of failure of equipment.

4. As an extra precaution, the power plant makes an automatic two-hour check of commercial power supply voltage after this voltage has returned to the correct range. If the commercial voltage remains within established limits, the unit returns the radar equipment to commercial power, shuts itself off, and returns to standby condition. [*Okay, but who sweeps up? Ed.*]

Manufacturer states that these units, available in all kilowatt ranges, can now be purchased commercially as a source of standby emergency power for hospitals, institutions, or any other application where it is necessary to assure a continuous power supply for important services.

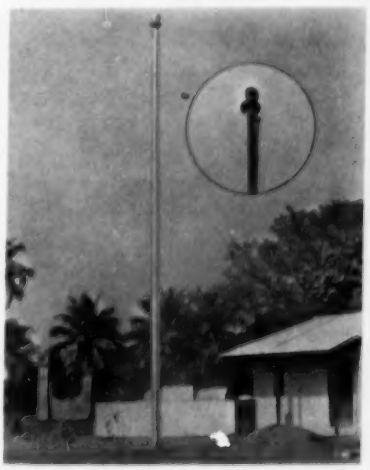
Power plants discussed here have a generator capability of 60 kw with 110-hp engines. The dual units with control cabinet are priced at approximately $20,000 — which does not, however, include remote control equipment.

Dual-Purpose Flag Pole Conceals Vent

NEW USE for tapered, seamless aluminum alloy poles developed by a Pittsburgh aluminum products firm was found by alert sewage plant engineers in Florida. Designed originally as flag standards, these hollow poles were adjudged ideal to serve as both decorative flag poles and sewage vent stacks.

The illustration shows installation of one of these pole vent stacks at a disposal lift station near Coral Gables, Florida. The 39-ft pole is directly connected to the system's main chamber and is mounted on a special base.

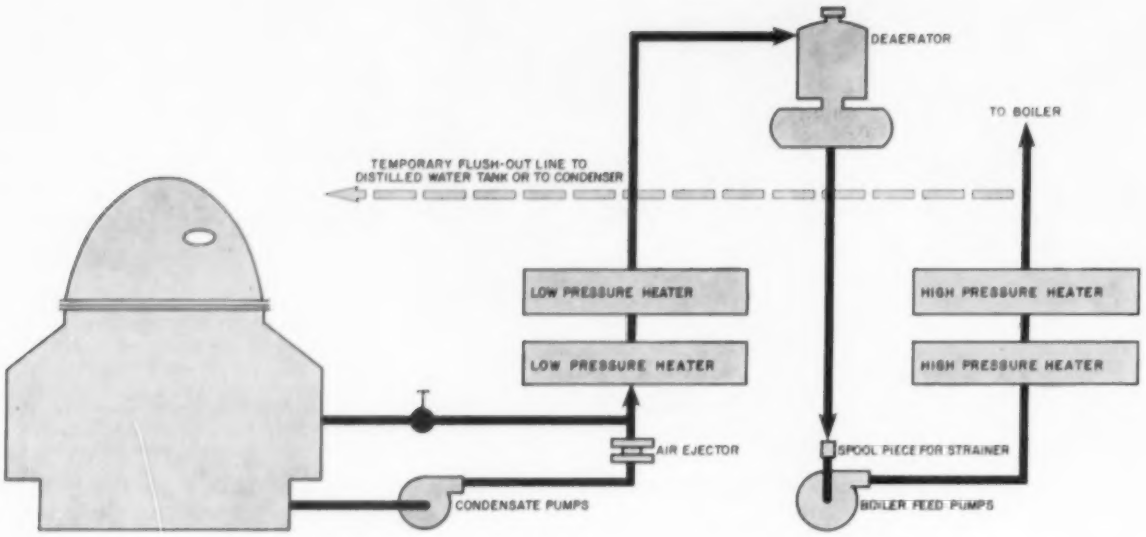
Three similar vent stacks operate nearby in the same system and others are in service elsewhere in Florida. Designers of the sewage lift station say the aluminum alloy poles were selected because of their strong resistance to corrosion caused by chemically active gases and seacoast atmosphere.



Flag pole shown here doubles as a vent stack for Florida sewage lift station

As shown by the inset in the illustration, the finial incorporates a diffuser plate and exhaust vents to discharge the gases carried to the top under pressure. Conventional flag fittings are included on the pole.

Anyone interested in solving a similar problem with this dual-purpose pole can obtain further details and manufacturer's name by addressing the Editor of POWER ENGINEERING or writing "Flag pole" on the postcard elsewhere in this issue.



How To Check Boiler Feedwater

By J. H. HUNNICUTT *

FIVE SEPARATE AND distinct operations are necessary to prepare the boiler feed water system for operation in a new plant:

1. Clean and inspect deaerator.
2. Reverse-flush the line from low pressure heaters to deaerator; flush boiler feed pump suction piping; install boiler feed pump suction strainers.
3. Check alignment of boiler feed pumps and drivers; clean boiler feed pumps internally.
4. Run-in boiler feed pumps on recirculation to deaerator.
5. Flush condensate and boiler feed water systems as a unit. Adjust level controls in system.

Deaerating feedwater heaters of the tray type are frequently received in the field with the trays in position. These should be removed so that the deaerator may be inspected; the trays are then cleaned, using a solvent if necessary, before they are re-installed. After removal of trays the deaerator should be cleaned internally, and any paint or preservative applied by the manufacturer removed with wire brush and scraper.

Preservatives in common use often appear to be effectively bonded to the metal surfaces only to become detached later when the deaerator is heated. Nothing plugs a feed-pump suction strainer quite so rapidly or effectively as these sheets of preservative coming down through the feed-pump suction piping.

The writer recalls with chagrin one instance when trays were not removed from the deaerator of a 66,000-kw installation. Everything appeared spotlessly clean when the deaerator manhole was opened. The manufacturer claimed to have used a water-soluble preservative on the internal shell and a spot test proved this to be true. Due to shortage of time and press of other operations, the deaerator was presumed to be clean.

Unbeknown to anyone at the job site, the manufacturer had also been very diligent in protecting the trays during shipment by using thin corrugated cardboard sheets between tray layers. The presence of the cardboard was not detected during the flush-out of the deaerator or the run-in period of the boiler feed pumps. When the system became hot during the ensuing start-up, however, six pipefitters working at breakneck speed could not change suction strainers on three feed pumps fast enough to keep any one of them in operation. Result: A costly shutdown to remove deaerator trays and clean the heater.

Moral: Don't Cut Corners

Never cut corners inspecting tanks and heaters. They are entirely too convenient as receptacles for used lunch bags, empty cigarette packs, etc. of the construction forces during the erection period. Debris of this type is much easier to remove during the normal course of inspection.

With all deaerator outlet valves closed, fill the deaerator with water through a hose connection to the vent condenser. Back-flush the line between the last low pressure heater and the deaerator (which, you will recall, is still open at the heater). † When clean, have pipe fitters make-up this connection for service and refill the deaerator preparatory to flushing the feed pump suction piping.

Remove the spool pieces in the suction piping before each boiler feed pump and arrange such temporary piping as may be necessary to carry flushing water away to the sewer. Flush the boiler feed pump suction main and branch lines to each pump thoroughly until the effluent is clear and free of debris. Insert cone type suction strainers in each spool piece and return these to the piping installation.

When To Remove Strainers

Strainers should be kept in service for the first week or ten days after FULL LOAD is placed on the unit or until repeated inspections show no further foreign matter being dislodged from the system. These strainers should be strongly constructed of 14-mesh by 0.02 in.-D wire screen, backed by ½-in. mesh by .063 in.-D hardware cloth brazed to a heavy ring gasket with handle to facilitate removal and cleaning.

With the exception of the turbine generator, the most precision-built equipment in any plant are the boiler feed pumps. The extremely close tolerances necessary to their proper operation render them highly susceptible to improper operational practices and, for this reason, common sense dictates that wherever possible they be made ready for operation under the supervision of the manu-

† See: How To Check Condensate System Before Plant Start-Up, POWER ENGINEERING, February 1957 issue.

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FOURTH of a group of articles, all related to initial operation of the new power plant, this section explains steps necessary to clean and prepare the boiler feed water system.

The author is expert in start-up procedures; it has been his principal job for many years.

Among future articles to appear in POWER ENGINEERING on this subject are the following:

- Cleaning of Auxiliary Piping
- Cleaning and Testing of Tanks
- Sore Spots to Avoid in Water System
- Instrumentation and Controls
- The Boiler (in four parts)
- The Turbine (in three parts)
- Preliminary Operation

Both the author and your editors welcome your comments and suggestions on this series of articles as they appear.

System

facturer's own service representative.

However, there are certain preparations that should be made before the service representative arrives at the plant that will conserve his time, hold the charges for his services within reasonable limits and greatly expedite the work of readying the pumps for operation. The coupling between pump and driver should be opened and, in the case of motor driven units, the motor bumped to assure proper rotation. The coupling should be left uncoupled and ready for alignment check.

All feed pump manufacturers give their equipment heavy internal coatings of grease to protect them during shipment and storage. This will have to be removed, and is most easily accomplished by alternately flooding the pump with hot water (180–200 F) to melt the preservative, and then with somewhat cooler water (90–100 F) to float the melted preservative out of the pump casing through the clean-out connection in the forward end of the pump body.

Bring Water To Pumps

Water should be introduced into the pump casing through a connection in the opposite end of the pump body. These connections are provided in the pump by the manufacturer, and are generally ½-in. holes drilled, tapped, and plugged. Water at the two temperatures may be brought to the pump through temporary ½-in. or ¾-in. copper tubing, valved and tee-ed into the supply connection of the pump. Wait until the service representative arrives before proceeding with the cleanout.

Install pressure gages (0–100 psi range) in the boiler feed pump suction piping at points just above and below the cone strainers. These gages are for the purpose of measuring the drop across the strainers and will serve as an indication of their cleanliness. When this pressure drop exceeds 20 psi the pump should be shut down and the strainers cleaned.

Boiler feed pump manufacturers unanimously agree that the most critical period in the life of a feed pump is during its initial start and the several minutes immediately following. This again is due to the extremely close tolerances employed and the likelihood of seizure if repeated starts and stops are resorted to before certain internal surfaces have had an opportunity to "wear in." For this reason every precaution should be taken to ensure that, once started, the pump will be able to continue in operation.

Check pump oil supply, available cooling water flow, and move all bearing oil rings manually before starting the pump to ensure freedom of movement. Go over all recirculation and drum balance piping carefully to assure that no obstructions exist and, if valves have been installed in these lines, either open the valves and remove the hand wheels or secure the valves in the open position with a chain and lock.

Fill the deaerator with demineralized or distilled water if it is available; otherwise use the cleanest, purest water obtainable. Add dissolved tri-sodium-phosphate and caustic soda as necessary to maintain the chemical balance at 90–100 ppm phosphate and pH 11.0 in essentially the same manner in which the condensate system was flushed. Open the suction valve to the pump to be run in and flood and vent the pump chamber. See that the pump discharge is CLOSED and that the recirculating and drum balance valves at the pump are OPEN.

Check Lube Oil Supply

Start the pump; check immediately to see that flow of lubricating oil to the bearings of both pump and driver is established, that oil rings are revolving, and that no excessive vibration is present. Maintain a close watch on the lubricating oil return to the oil cooler and when oil temperature reaches 110 F cut in the cooling water supply to the bearings and lube oil cooler. Pump packing-gland leakage should be somewhat profuse when the pump is first started but as the packing wears in, gland nuts should be tightened gradually and evenly until only a bare trickle, sufficient to cool and lubricate the packing, is present. Continue running-in the pump on recirculation to the deaerator, maintaining a close watch on bearing temperatures.

With the supporting jacks in place under the condenser, fill the hot-well with the same type of water used to fill the deaerator and adjust it to the same chemical balance. Have pipe fitters run a temporary pipe from a point in the boiler feed line as close to the boiler as possible to the distilled water storage tank if such is installed; if not, it should be run to the open manhole in the turbine exhaust casing.

As the boiler feed pump continues to run on recirculation to the deaerator, the water in the system will pick up heat. Temperature should be regulated to between 180 and 200 F by cracking open the pump discharge valve to bleed water into the higher pressure feed water heaters; replace the water thus bled off with the cooler water in the condenser, using one of the condensate pumps to transfer the cooler water to the deaerator.

Continue the operation until all feed water heaters are filled and water is circulating through the temporary piping to the distilled water storage tank or the condenser, as the case may be. Adjust and maintain adequate levels in the condenser hot-well, deaerator, and distilled water storage tank. Increase the flow through the heaters to attain greater flushing velocity.

This flushing operation should be continued, changing feed pump suction strainers as necessary, until a minimum of eight hours trouble free run-in time has been attained on each feed pump. If the water in the system becomes highly turbid it may be desirable to suspend operations temporarily, drain and refill the system, and then continue the flushing operation. At the conclusion of the flushing period the entire system should be rinsed with the purest water available and then flooded with water containing a very slight excess of sodium sulphate to inhibit corrosion.

Inspect Pump Thrust Bearing

The boiler feed pump thrust bearings should now be dismantled and inspected. Various authorities differ as to the necessity for this inspection, but the author feels that it is a desirable precaution to be undertaken while the pump manufacturer's service representative is available.

This procedure for cleaning condensate and boiler water piping is admittedly more elaborate and time consuming than methods in common use prior to the last year or two. It is felt, however, that the benefits to be obtained from the chemical cleaning under conditions of heat and mass velocity flushing far outweigh the disadvantages in terms of low silica values in boiler feed water when the unit goes into operation. When this method of cleaning is employed and provisions are made to waste feed heater drips to the sewer for the first few hours of operation, no trouble should be experienced in controlling silica below the 5 ppm level.

An additional benefit to be derived from this method is the opportunity to adjust and pre-set all level controllers in the system under closely simulated operating conditions during the flushing period.

Build Your New Boiler Plant Right!

You have foreseen and corrected factors in your plant design that could give you problems later in operation and maintenance. Now you must see that the plant is built properly to get the results you want. Here are tips on how do to it from a man who has done it

By PAUL N. GARAY *

WHEN YOU and the designers of your new boiler plant are planning it, you can do a number of things to solve or eliminate a number of the small but annoying problems that often come up after a plant is in operation. Taking as an example an actual plant containing two boilers of 140,000 lb per hr capacity each, with necessary auxiliaries, this writer showed in the December 1956 issue how some careful thought in the planning stage would cut operating and maintenance problems and costs in the finished plant.

So, having done this type of careful design planning, we have now reached the point at which we are ready to begin construction of our plant. Assuming that we have an acceptable set of plans and specifications, how then can we, aside from adherence to good construction practices, assure ourselves of the best and most trouble-free installation possible? Well, the phrase "in accordance with standard practice" leaves a wide-open area for improveing our installation. Rigid inspection will insure that plans are followed, but too much is usually left to the builder's competence and good will.

In the average set of plans and specifications it is difficult to show completely and in sufficient detail each of the many features which are referred to as "being in accordance with good practice." Good practice? One definition of it could be "that procedure which will result in a minimum of maintenance within the budgetary limitations of initial construction expense." Here, then, are presented some of the points which may differentiate between good and bad practices. The material and the design cannot be changed; but based on experience with actual construction, these tips, applied with common sense, can benefit you.

Look at Piping First

Our discussion can be divided broadly into the following categories; piping; valves and traps; boiler installation; machinery and equipment installation; building features, general suggestions.

Inasmuch as the piping is the skeleton of our plant, this is the first logical area in which to look for problems and their possible solutions. An excellent way to begin a survey is by reading the American Standards Association recommendations for safe piping. These are to be found in ASA Specification B31.1, Code for Pressure Piping Safe Practices, and ASA Specification B2.1, Taper Pipe Threads. Additional information can be gleaned from B16.9, B16.5, B16.11, and B36.10, which gave details respectively for steel butt welding fittings, forged steel flanges, socket weld fittings, and schedule of wall thicknesses.

Watch Threaded Joints

If you have ever watched the average pipe fitter at work, you will note that he makes up threaded pipe joints quickly and completely. He will bend the wrench to tighten up the joint. He will use plenty of joint compound. He will show by hydrostatic test that there is not a drop of leakage. Is this a permanently tight system?

Not necessarily, especially if he has committed one or more of the following sins: threads not cut cleanly, or chipped, due to dull cutters; insufficient lubrication or improper cutter setting; proper number of threads not engaged; threads crossed and subsequently restarted; use of the wrong compound for the service intended. Vibration, thermal effects, and pipe motion may eventually loosen up threaded joints unless the threads are properly made up. If the hydrostatic test shows leakage, excessive pressure from an oversized wrench may stop the leak, but only temporarily. If a threaded joint does not make up properly with moderate torques, the threads are not properly mated.

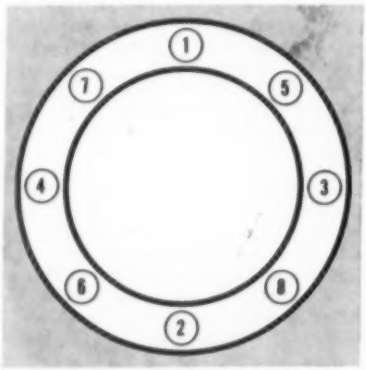


Fig. 1. Everybody knows this is the way to tighten flange bolts—but do they always do it? Right way keeps 'em tight

Although screwed connections should be avoided, economy requires that pipe systems under about 2 in. be made this way. Larger pipe sizes, however, and especially when carrying steam, should be made up with flanged, bolted joints. When these are made up, they should first be properly aligned by the use of feeler gages. The pipe should be so supported that the joint will not be required to support any of the weight. Gaskets of the proper resiliency should be used, and if the joint is to be occasionally broken, one face of the gasket should be graphited. Flange bolts should fit freely and without forcing, and no effort should be required to bring the mating flanges into contact. Distance pieces or "Dutchmen" should be used to make up gaps between flanges.

Bolting should be done by tightening diametrically opposed bolts in sequence to about ⅓ of final tension, as shown in Fig. 1. After initial loading, final torque, using a torque wrench, should be applied to produce an original stud stress as shown by Table B. On completion of bolting of each joint, each nut should be backed off ½ turn to relieve torsional stress and torqued to the final value.

Table I, applicable to bolts treated with anti-seize compound, shows torque vs. bolt stress.

Using the foregoing method of bolting, stressed to 30,000 psi, plastic gasket flow and stud relaxation will cause stud tension to become static at about 20,000 psi. Therefore, the stud load at time of checking should be minimum 20,000 psi, or maximum 30,000 psi. The above ratios will hold for other values of bolt tension.

It has been determined that a maintenance man using a lever and wrench can apply a 52,000-psi stress to a ¾-in. bolt and a 45,000-psi stress to a 1-in. bolt. It is obvious that smaller bolts can easily be overstressed.

Pipe Supports

Piping should be supported to minimize motion of any kind, but provision should be included for thermal expansion by use of loops or expansion joints. Water hammer will cause appreciable motion of piping and, in extreme cases, can quickly loosen

* Systems Engineer, General Electric Co., Atomic Power Equipment Department. The present article, also the one entitled Don't Build Problems Into Your New Boiler Plant, December 1956 issue, are based on the author's previous wide experience in important industrial steam power plants

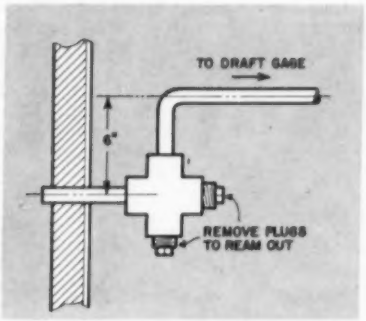


Fig. 2. To prevent draft gage connections from plugging up with dust right at the boiler, use a cross this way

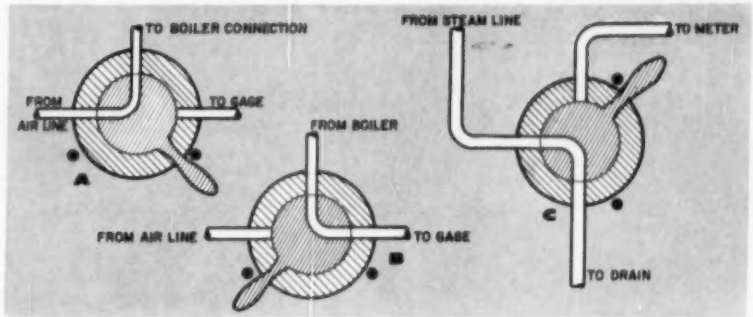


Fig. 3. To blow out draft gage connections, use 3-way cock as at (a) and (b). Same type useful to blow down the liquid and steam lines to a meter as at (c). Place cock at bottom of U bend. Steam pressure at all times to press plug against seat

joints. Even the dynamic force of a high-speed fluid flow changing direction will be enough to cause pipe motion unless the pipe is completely supported. Large pipe may be fitted with resilient supports that will permit a restrained motion.

Some thought in installation may eliminate headaches later. Include in each pipe run a sufficient number of unions or flanges so that the pipe can be taken down, if necessary, in convenient sections. In the case of screwed piping, this provision is especially desirable. The line should be so pitched as to provide a continuous downhill run for the fluid, so that water pockets in steam lines will be avoided. Steam take offs should be from the top of a pipe to minimize moisture carryover, and metering lines or tubing connected into a much larger pipe should go into the side or top of the larger pipe. To connect to the bottom will insure the collection of troublesome sediments in the small lines.

Meters, Gages, Controllers

When installing meters and gages, some provision is usually made for blowing down the line. However, be certain that the blowdown valve or plug is placed so that the lowest part of this pipe run can be blown clean. I have had considerable trouble with the installation of ring-balance meters where the blowdown was placed above the connection into the meter case. However, inside the case, the pipe continued down about a foot, then up to the internal meter tubing. Sediment tended to collect in this U bend which could only be blown out by removing some of the pipe inside the meter case.

Avoid, also, blowdown lines draining on the floor; if you can't carry them to a funnel drain, at least carry them to a point where you can conveniently catch the drainage in a bucket. Speaking of drains, a strong recommendation can be made for a 3-in. funnel drain leading to a fuel oil tank to get rid of buckets of fuel oil or washdown kerosene. If desired, this drain can incorporate a separating tank. Water is then drained from the bottom and oil from some midpoint in the separating tank.

In some piping, such as the piping between the boiler flues and the damper controllers, the workmanship may be very careless, on the grounds that a leak won't bother anybody. This may be so in some cases, but I was very much bothered by occasional non-functioning of a damper controller, and it took a long time to track the trouble down to a leak in a carelessly-installed union. In this instance, the lines to several controllers were fitted with orifices to reduce the sensitivity of the system. The orifice was, believe it or not, a disk which had been knocked out of an electrical outlet box. The discarded disk had been drilled and squeezed between the two halves of a union in the line!

Upon further investigation, I learned that apparently this was common practice. Obviously, such an installation will not be dependable nor consistent with its operation. Low-pressure orifices should be installed so as to be tight but accessible for inspection or cleaning. Incidentally, when making up or cleaning lines connected to draft indicators or low-pressure controllers, care should be taken to see that such lines are not blown into unless the gage or controller connections are completely removed. These devices are very sensitive and are easily damaged with slight air pressure.

Blowing Out Gage Lines

Fire-box end of a draft gage line will frequently be blocked by condensed solids for about 6 in. outside of the boiler casing. Therefore, at the boiler casing, the connection should include a plugged cross, as in Fig. 2, so that the pipe can be reamed out from two directions. I have seen these lines so solidly blocked that they withstood 100 psi air pressure. A further improvement is to connect the meter line to an air blow through a three-way cock, Fig. 3a, so that a turn of the cock will cut off the meter and blow the line. (See Sketch 3a). *Use care to see that air cannot be put on the meter with this hookup.* This same type of cock can be used conveniently to blow down liquid and steam lines.

When considering the use of copper or steel tubing on high-pressure lines, do not trust solder. Our remote water-level indicators were connected to the boiler drum by high-pressure soldered tubing. So long as the lines were filled with cool condensate, everything held fine; but when we decided one day to blow the lines down, the hot steam promptly popped all the joints. Now, flared fittings have been installed on all tubing joints.

Sampling Lines

You may wish to take samples of liquid or steam from time to time. Make provision now for connections to draw off your sample. Steam samples, of course, will require a sample cooler. For occasional use, a copper coil in a bucket of water will suffice. A calorimeter connection — just a valved tee — will be found useful for performance tests when desired.

Table I. Showing torque vs bolt stress

Stud Size	40,000 psi	30,000 psi	20,000 psi
½ in.	40 ft lb	30 ft lb	20 ft lb
⅝ in.	80 ft lb	60 ft lb	40 ft lb
¾ in.	132 ft lb	100 ft lb	66 ft lb
⅞ in.	212 ft lb	160 ft lb	106 ft lb
1 in.	328 ft lb	245 ft lb	164 ft lb

Table II. Showing bolt stresses and gasket materials for various types of service

Type of Service	Maximum Stress	Gasket
Superheated steampipe of over 400 PSI	30,000 PSI	Spiral metallic gasket
	40,000 PSI	Serrated soft steel
Other high-temperature, high-pressure lines using alloy steel bolts	½ the elastic limit of the alloy	Flat sheet
Medium and low-service lines using mild steel bolts	½ the elastic limit of the bolt material	Flat sheet

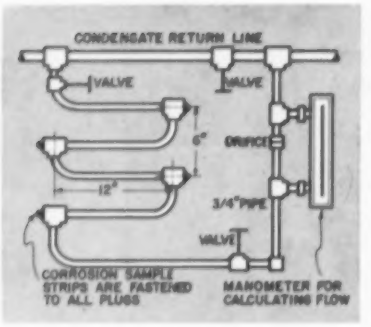


Fig. 4. To test for corrosion in condensate return lines, you can install a corrosion sample tester as shown here or you might use standard NDHA tester or New Bureau of Mines tester, shown in the February 1957 issue, page 67

In this connection, are you planning a performance test of your boilers? Where will you put the steam? Blowing a high-pressure steam line off to the atmosphere may bring the police down on your neck, so you must decide now what to do. At least, provide a large connection so you can let off steam, once you've figured out what to do with it.

You may find it necessary to check for CO_2 corrosion in your return condensate lines. A corrosion sample tester, as shown in Fig 4, should be installed for this purpose.

Don't forget warm-up by-pass lines on turbines, soot blowers, and other items of equipment. A warm-up line can extend the life of your main stop valve indefinitely by preventing wire-drawing in the larger valve. Note that, commonly, a by-pass around a valve, meter, trap, or other small item of equipment might be as in Fig. 5a. Such a by-pass is difficult to make up tightly, as the small sections must be cut perfectly.

To make up this type of by-pass, the plumber will usually bend the pipe to close up the union, or he will back off on each of several threaded joints to make the last union fit. I have seen the fittings backed off up to ½ in. to make the union fit! The hookups shown in Figs. 5b or 5c are much better, because the last union can be made up without forcing.

Make provisions with plugged tees or valves in your system to take off service steam and water. For instance, now that water washing of boilers is quite common, a water supply for this purpose should be provided. Don't forget to also provide a firebox drain. Don't forget to see that drains for fan scroll casings are provided. The drain lines on induced fan casings should be easily and readily cleaned, since they tend to clog up with fly ash.

Remember also to carry all your drain and blowdown lines from all your equipment to points convenient to the operator. As an example, consider our three-way non-return valves on the main steam lines which were designed to shut off, to check, and to act as an automatic safety stop. The safety feature was designed to be tested by opening a test valve, but the test valve was never brought down to the operating level, and, as a consequence, the valve was very seldom tested. This, too, was corrected by the builder after some delay.

In this age of modern materials, we no longer have to put up with previously insoluble corrosion problems. For CO_2 meter piping, chemical feed piping, brine piping — all highly corrosive services — insist on stainless steel or polyvinyl piping. It's a safe bet that you'll at least get the polyvinyl pipe. This is excellent material so long as the temperature is not above boiling.

One source of annoyance and delay is the searching for the proper tube or control line when something is out of order. With fifteen or so control tubes coming out of a boiler casing, it is a wise precaution to tag or label each tube of a group with its service. (Labelling should be used also on electrical circuits either by coded insulation or by tagging.)

Distribution Piping Problems

Distribution piping brings problems of its own if carelessly installed. Long runs of pipe should pitch accurately to trapped low points. Underground pipe will encounter corrosion and galvanic effects. Such underground gas and water pipe should be well wrapped, and all pipe joints should have an electrical jumper connection. Such a piping system can be protected against corrosion at very low cost on a new installation and will avoid later costly repairs.

Another important consideration is room — room enough in a pipe tunnel to support all piping on racks, with some separation between individual pipes for access by a maintenance man and room for him to use his tools.

And now for a few tips on valve installation. Check to see that handwheels are readily accessible. Feedwater bypass valves, soot blower root valves, and other important stops should be provided with operating chains for convenience. Hard facing or special throttling disks should be used in soot-blower valves and other valves where throttling may occur.

When installing valves, carefully observe the following points:

1. Line up and support line pipes before valve is installed;

2. Close valve before installing. Chances of distorting the valve will be less this way;

3. Do not install valve until the line has been blown clean first;

4. Do not overcut or undercut threads. If not enough threads are cut, the joint may leak. If too many threads are cut, the pipe may butt up against the inside of the valve body;

5. Do not put pipe compound on the threads inside the valve body. Put the dope on the threads of the pipe.

Valves should be selected for a particular service. In general, categories in the average plant are: low-pressure hot or cold water, hot water at high pressure, saturated steam, hot oil, high-pressure or superheated steam. Valve parts and packings should be matched to these needs for adequate service.

Unless the valves are fresh and ordered for a specific service, you may find it economical to replace the packings with the type packing best suited for the definite service before using the valve. I have found that in many valve installations, unless the packing is suited to the specific service, trouble will be experienced at a later time.

Group Valves for a Unit

If possible, valves should be grouped so that the operation of a unit of equipment is possible from one point. For instance, with some thought, the piping to a fuel oil heater unit can be arranged so that the operator

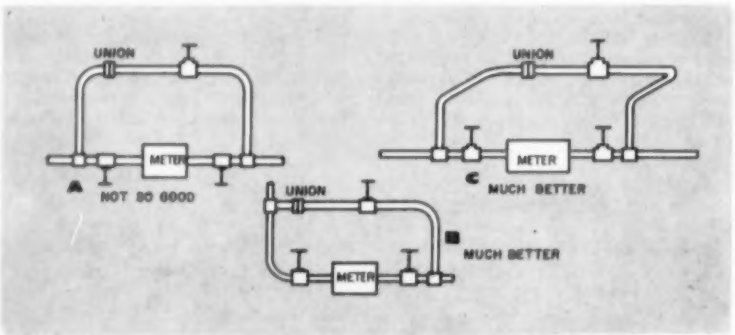


Fig. 5. In installing by-pass lines on a valve, meter or trap, Plan (a) is hard to draw up tight unless small sections are cut perfectly. Plans (b) and (c) are much better, because they can be drawn up without forcing the union or bending piping

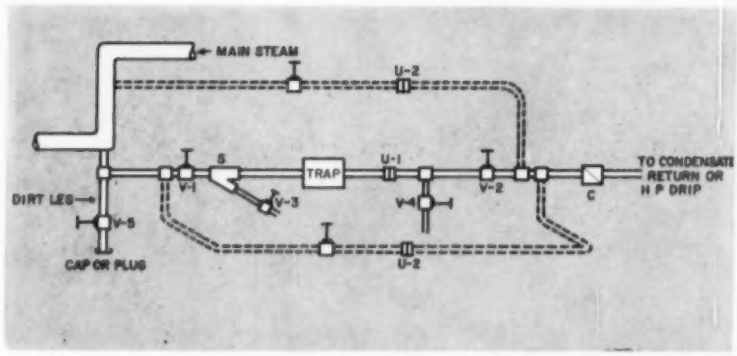


Fig. 6. Install your traps properly, like this (solid line). V1, 2, 3, 4, 5 = valves; V1 and 2 = unions; S = strainer; C = check valve. If by-pass is needed, use either of hook-ups shown dotted; offset hook-up is one recommended by author

can start and operate the heating set without having to walk around or climb up on it. One of the hallmarks of an expert installation job is a neat, compact valve lineup.

Similar to valve installations, traps will require a minimum of maintenance and will operate with a maximum of dependability when properly installed, as in Fig. 6.

Install Traps Right

The trap should be installed in a drip pocket ahead of a riser or ahead of a dam in the pipe. When installed ahead of dams, in long straight stretches of pipe, the dams should be placed 300 to 800 ft apart. Backsealing water should be provided by fitting a priming connection.

In Fig. 6, note that the trap is fitted to the downward extension, which forms a condensate pocket and dirt leg. A valve V5 is provided for a free blow, and a plug is in the end of the line in case the free-blow valve should leak. In some cases, the free-blow valve may be on a separate leg, and the dirt pocket is sealed off with only a plug. Next, have valves V1 and V2, to shut off the trap in case repair is required. Check valve C is required so that reverse flow will not occur into the steam line. At S is a strainer, fitted with a blowdown valve, V3. If expense is a consideration, use a plug instead of the blowdown valve at this point. U1 is a union. At V4 is a test valve to provide a simple and convenient means of checking the operation of the tap. A cheaper test facility would be a plugged tee, instead of valve V4. If extreme economy is desired, omit valve V4, but be sure that union U1 is on the discharge side.

If a by-pass is desired, as when draining long cold lines, install the bypass, as previously noted in Fig. 5, with a double offset (shown by the dotted line) putting union U2 on the downstream side. A still better by-pass is shown by the broken line.

And, of course, for proper operation of valves, traps, and other equipment components, piping should be blown clean, flushed out, and sealed as each section is completed. If practicable, clean the piping by brushing or wiping out.

Temporary cloth mesh bags may be fitted in large pipes ahead of critical units. You'll be surprised at how many pieces of wood or concrete are still in the system even after extensive cleaning.

Smaller components of your plant should also be carefully installed. Thermometers and gages should be turned or angled for easy reading. Gages should be fitted with shut-off cocks and plugged tees for easy attachment of a test instrument. Have your contractor promise to install snubbers or pulsation dampers on gages which show vibration. Large pressure gages will quickly wear out if the mechanism vibrates continuously. This vibration may be very evident on feed pump discharges.

Inspect to see that fittings are readily accessible for greasing soot blowers conveniently. This same philosophy applies also to other units, such as fan and stack dampers, fittings, bearings, and many other locations.

Have your inspectors check and recheck plans against installations.

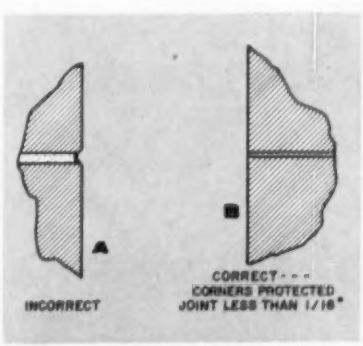


Fig. 7. In laying up refractory brickwork, do not permit structural brickwork joints as at (a). Instead, use joints 1/16-in. or less, square edge as at (b)

Reading the manufacturer's instruction or installation data will often enable you to spot a sub-standard or incorrect installation. A case in point is the installation of soot blowers on our boilers. We had on each boiler five soot blower heads made up of two different materials, depending on the temperatures existing at the point where the soot blower was used. Since both sets of soot-blower heads looked exactly alike, it was well we checked the prints with numbers stamped on the blower heads. Because the low temperature units had been installed in the high-temperature area!

Reducing and safety valves should be accessible for servicing and adjustment. Safety valves on steam drums should be so installed that escaping steam or condensate is carried at least 7 ft above the building roof, and no hazard should exist to any personnel standing near a blowing safety.

Check Machinery Installation

Machinery installation can be correctly done, or sloppy, at the same cost. Alignment, expansion, and positioning should be considered. On turbines or pumps not fitted with expansion joints, allow 10 to 15 diameters of pipe, preferably with a double elbow, to absorb thermal stresses.

Turbines and pumps should be placed on proper bases, carefully aligned and properly grouted. Alignment of drive couplings should be by feeler gage and should, when hot, have no angular error, no height difference, and no sideways displacement. The contractor should re-check the alignment after six months of operation and should then pin both driver and driver units to the base plate.

Oil drain lines should be so placed that the sumps can be drained completely; and overflow lines, as on bearings, should be placed at the correct level. Sight glasses connected to bearings or tanks by piping should have the normal level marked to correspond with the correct level which should exist in the sump. I have seen sight glasses on a bearing show normal level when the bearing oil level was dangerously low.

Dampers and control arms should be marked to show "open" or "closed" positions. Don't depend on the operator to remember the correct position of an operating arm when he is confronted by an emergency.

Remote operating rods or chains should be included on important or frequently used items of equipment. In this day of reduced operating staffs, it is well to have everything close and convenient to the main portion of the operating floor.

Installation of electric motors, switchgear, and meters should be such that they will be dry regardless of leakage of steam or water from nearby equipment. How many cases have you seen similar to that of a condensate *continued on page 116*

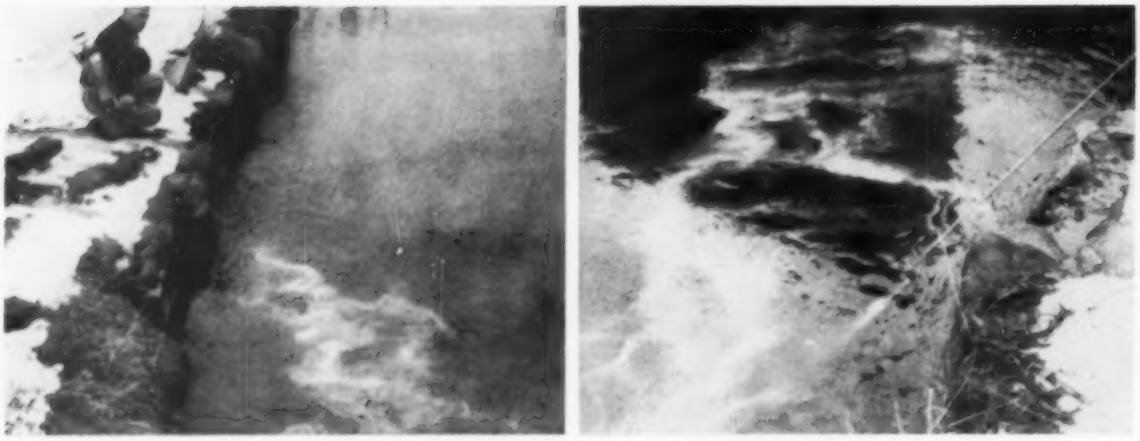


Illustration shows how new spray compound emulsifies oil in water. White emulsion breaks oil film into small globules, each insulated from others by an envelope of surface acting agent. Break-up of oil slick can be seen in photo at right

Get Rid of Oil Spills This Easy Way

OIL SPILLS ARE messy, difficult to clean up, and may become a fire hazard or water polluting agent — particularly when large quantities are involved. A new emulsifying and degreasing compound, called MM-17, makes the clean-up job easier, safer, and faster.

On concrete or similar surface, simply spray the liquid compound evenly over the surface of the spilled oil with an ordinary garden-type sprayer, brush it in with a stiff broom, then wash away the emulsion with water.

If the spill is on water, spray with MM-17 to break up the slick; the compound emulsifies and disperses the oil, preventing pollution complaints and danger of fire.

Flash point of the compound is 160 F; it does not give off toxic fumes and has no burning effect on the skin, making it safe and easy to handle. (MM-17 has Coast Guard Certification No. 281.) Normally applied with either a hand or power sprayer, a satisfactory job can be done with a watering can in an emergency.

The compound has many other applications in the power plant; a partial list includes cleaning oil preheater coils, cleaning sludge from oil storage tanks, degreasing machine parts, and other cleaning jobs involving greasy surfaces or equipment.

Among the power companies using the compound are Cambridge Electric Light Co., Public Service Co. of N. H., Boston Edison Co., and Brockton Edison Co.

Want more information? Write the Editor, POWER ENGINEERING, 110 S. Dearborn St., Chicago 3, Ill., if you want more data on MM-17.

More Test Runs for Basic Coal-Bin Design

BITUMINOUS COAL RESEARCH, INC is continuing extensive test runs to develop a comprehensive engineering basis for the design of coal storage bins. Experimental equipment is being used to evaluate the effect of such factors as coal moisture, coal size, ash content, and coal origin on bin design and coal handling.

Complete automation in boiler plants depends on automatic discharge of coal from storage bins as well as on automatic burning equipment. For the most part, says BCR, the design of coal bins is still based on rule of thumb methods; it is hoped that BCR's work will supply constants for a number of coal variables and permit the development of a rational basis for the design of coal bins and hoppers.

If this hope is realized, such a quantitative method of bin and hopper design would be of immense value to utility and industrial users of coal. The operation of coal preparation plants and dock-side coaling stations would also be made more efficient.

During the summer, test runs using ¼-inch by 0 coal with moisture ranging from 3½ to 11 per cent by weight moisture, were made to investigate:

1. use of fiberglas tapes in breaking up coal pressures within the bin and helping the flow of coal;
2. effect of bin wall feeding using fiberglas tapes;
3. use of pressure breakers inside the bin; and
4. use of combination hoppers.

Currently, test runs are being made to find a bin system which will give:

1. unassisted initial outflow of coal when opened;
2. non-interrupted flow of coal after intentional stoppage:
3. complete and practical utilization of the bin's capacity; and
4. full use of the entire outlet area thereby permitting a smaller diameter outlet.

While all the tests to date have been made with a cylindrical-conical-bottom bin, a study will also be made of silo-type bins containing live storage shelves.

This testing should yield results of the highest value to every coal-burning plant, large and small. Time after time, in visiting industrial power plants, the editors have seen, or been told about, troubles with coal in bins and bunkers. Various power utilities have, of course, been forced to study this subject intensively and one of the best programs of this kind was a study of Flow of Coal in Chutes by Wolf and von Hohenleiten of Baltimore Gas & Electric Co, published in *Power Plant Engineering* (now POWER ENGINEERING) July 1945. That study was used as a basis for design of coal chutes at plants of the authors' company, and subsequently those of other utilities. It also affected bunker design. But the present BCR work will have much wider application, especially in smaller coal-burning plants, and that's where it is needed most.

Makeshift Rig Performs Quick, Low-Cost Electric Generator Repair

By LLOYD McWILLIAMS *

WHEN an 80-ton rotor for a hydroelectric generator was accidentally dropped, the bearings were destroyed, the shaft bent, and damage was done to the hub of the rotor. The 20-in. diameter 15-ton shaft was sent to an outside engineering works to be straightened and rebuilt; the bearings were rebuilt; but the 80-ton rotor, for obvious reasons, was a problem. It would have required a special depressed car for shipment. The only firm that could handle the piece was 400 miles away; delivery was three months and we needed the unit's capacity badly.

Accompanying photographs show how the job of re-boring the rotor hub was handled on the site. Truly a makeshift arrangement, Fig. 1.

Problem was to true up the inside diameter of the hub, which was slightly cracked and out of round; also the shaft, at the hub location, had been built up slightly oversize.

The rig shown was on the job, and had been designed by one of those old Joe's — of which there are not many left — for the purpose of boring out lignum-vitae turbine guide-bearings. It consists of nothing more than two spiderlike frames, Figs. 3 and 4, which are bolted to each end of a bearing. A shaft, carrying an arm and cutting tool, rides in bronze bearings. The shaft has a keyway throughout its entire length, Fig. 4, and a feed-screw with a sprocket at one end strikes a dog on every revolution, advancing the tool.

What would have normally been a large boring mill job, was, with this contraption, and with a lathe as the driving medium, Fig. 2, successfully accomplished.

* Maintenance Supervisor, Shawinigan Water & Power Co.

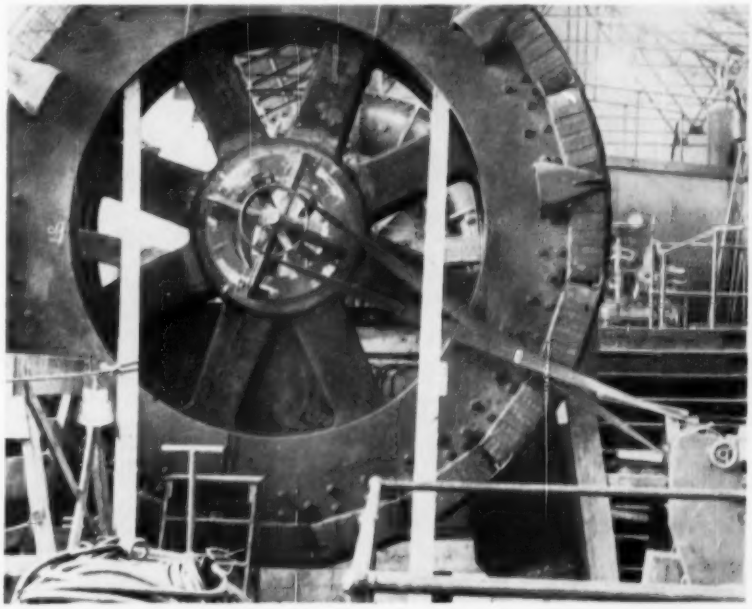


Fig. 1. General view of makeshift rig used to bore out hub of generator rotor

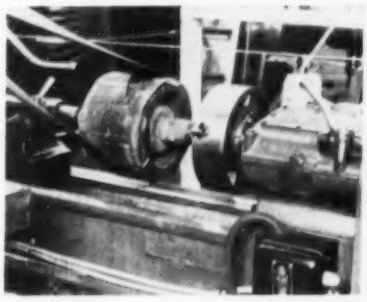


Fig. 2. Lathe from the shop set up to drive boring tool. Some speed control is always desirable for such jobs

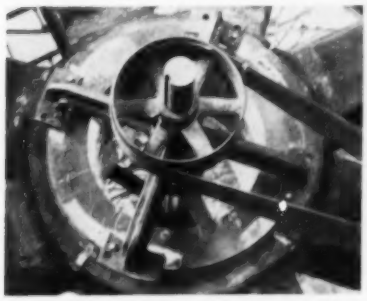


Fig. 3. End from which rig was driven

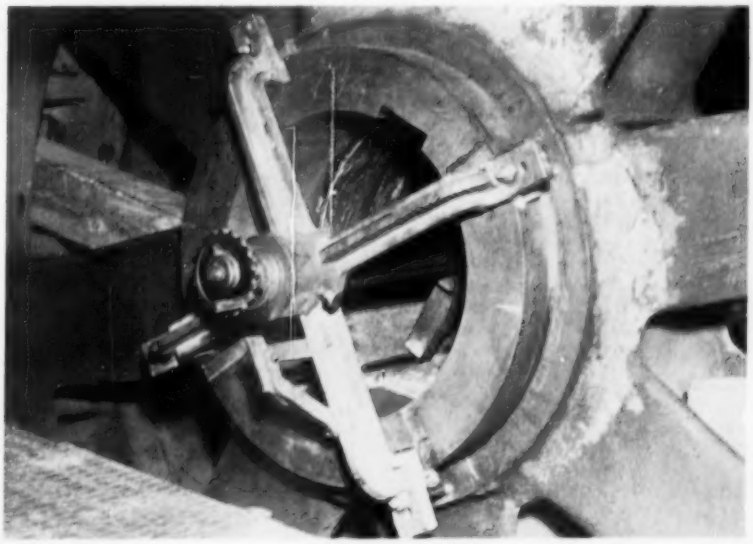


Fig. 4. This view shows the sprocket on the feed-screw, the dog, and the arm that strikes it at every revolution to advance cutting tool inside hub. With this rig, generator rotor hub was rebored on site, saving much time and money

Factors Influencing Starting Duty Of Large Induction Motors

Under stalled conditions, large induction motors are generally limited by reaching maximum rotor temperatures before reaching maximum stator temperatures. This article discusses the various factors which influence the heating of both rotor and stator under various conditions

By V. J. PICOZZI *

ELECTRICAL ENGINEERS responsible for the selection and installation of large induction motors are usually familiar with the characteristics of such motors in the region of full load and have little difficulty in selecting control components such as fuses, thermal overload relays, and other equipment for protecting the motor from sustained overloads near full load. In many applications, however, it is not full load operation, but the starting period which imposes the most severe service on the induction motor. Therefore, the greatest risk of failure may be in the service it receives during that interval.

Information regarding the starting characteristics of large induction motors and data on motor limitations under the particular starting conditions in individual applications are often difficult to obtain and for this reason a discussion of the limitations of large induction motors under stalled and starting conditions may be of benefit, not only from the control point of view, but also from the application standpoint. For induction motor sizes ranging from 4000 hp through 250 hp, safe stall times are of the order of 4 to 20 sec. depending on the type of motor design.

Overheating: Starting, Stalling

During the starting period the motor may be limited by either the rotor or the stator heating. While the rotor winding of a squirrel cage induction motor can operate at temperatures significantly higher than the insulated stator winding, the rotor may reach its maximum safe operating temperature during starting before the maximum safe allowable stator rise is achieved. Under this condition the motor is *rotor limited*.

Overheating of the squirrel cage rotor can result in the following types of damage:

1. Cracking of bars and end rings (particularly on repetitive stalling and starting) due to the mechanical stresses caused by expansion of bars and end rings.
2. Melting of aluminum in the case of the cast-aluminum rotor.
3. Loosening of the rotor core and separation of rotor punchings due to oxidation and deterioration of punching enamel.

If the stator temperature reaches its maximum safe value before the rotor under stalled conditions, the motor is considered *stator limited*. Except under unusual conditions, however, it is the rotor that limits maximum safe stall time. Overheating of the stator due to locked rotor conditions can result in the following manifestations of damage to the stator depending upon the degree of overheating.

1. Rapid insulation deterioration and possible immediate failure of windings.
2. Melting of soldered connections.
3. Burning of stator iron due to winding failure.

Allowable Stall Time

An induction motor can only withstand locked rotor conditions for a definite period without incurring some damage of the type mentioned. This safe stall time should not be exceeded and control protection should adequately guard against such an occurrence.

The motor designer can only determine the safe stall time of the motor after the motor design has been completed for a given application. For this reason the stall time data for a given motor may not be immediately available to the control engineer.

The basis for the allowable rotor temperature rise is dependent upon the ability of the squirrel cage to dissipate losses in its bars and end rings. The safe allowable temperature rise will depend upon what the particular manufacturer has determined by his experience to be a realistic limiting value. Rotor cage temperatures of the order of 200 C to 300 C are considered satisfactory for starting periods for brazed cages of large motors. The loss per cubic inch of end ring material is always kept appreciably lower than the loss per cubic inch of bar material to minimize end ring expansion which will result in high mechanical bending stresses of bar extensions. Long bar extensions between the end of the rotor stack and the end rings will also be utilized to reduce such stresses.

In general, safe stall time calculations are based on the temperature rise of the bars and end rings, assuming that since the heating period is short, all I^2R energy stays in the cage and raises the temperature of the end rings and bars according to the specific heat of the rotor material. Since stall times are inherently short, this method of calculation gives good results. Typical formulas for stall-time temperature rise are given below for copper bar and cast aluminum rotors respectively:

$$\frac{\text{deg C rise} \times \text{lb of rotor copper}}{5.6 \times \text{kw rotor loss under stalled condition}} = \text{stall time}$$

$$\frac{\text{deg C rise} \times \text{lb of rotor aluminum}}{2.6 \times \text{kw rotor loss under stalled conditions}} = \text{stall time}$$

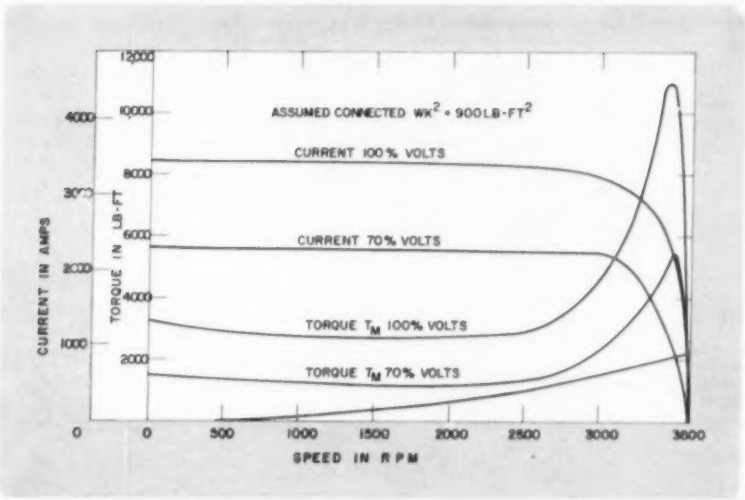
$$\text{kw rotor loss} \simeq \frac{\text{phases} \times I^2_{st} R_{st}}{1000}$$

For the general case, the manufacturer may modify this temperature rise by constants to take care of the heat conducted to the iron, etc., during the heating interval.

The kw of I^2R loss in the rotor, of course, takes into account the deep bar effect of the rotor slot which increases the effective rotor resistance significantly over the d-c resistance value, and may be several times the d-c value at start. This is an extremely important point since the rotor resistance determines the starting torque of the motor in accordance with

$$T_{st} \simeq I^2_2 \times R_2 \times \frac{7.04 \times \text{phases}}{\text{synchronous speed}}$$

* General Electric Co, Schenectady, N. Y.



Showing relations between Speed — Torque — Current Curves of Large Induction Motors

Maximum safe stall times = 12 seconds. Stator rise for one acceleration at 100 per cent voltage = 32 deg C. Rotor rise for one acceleration at 100 per cent voltage = 112 deg C. Stator rise for one acceleration at 70 per cent voltage = 49 deg C. Rotor rise for one acceleration at 70 per cent voltage = 155 C.

Since the starting torque of an induction motor is proportional to the I^2R_2 loss of the rotor it is apparent that for the same volume of cage material the higher the starting torque the lower the stall time for the same inrush kva.

Calculation of the time for the rotor to reach its temperature limit is approximately in the same manner for the rotor. The allowable rise will be modified to allow for the type of insulation used. Generally temperatures of the order of 125 C for Class A insulation, 145 C for Class B insulation, and 220 C for Class H are permissible for short time starting conditions. While these temperatures are higher than the hot spot temperatures for motors wound with these insulations they are of the same order as the baking temperatures of the insulating varnishes used in the manufacture of coils and motors. Also, since the period of operation at these temperatures are extremely short the insulation life is not appreciably affected. Since the a-c and d-c resistance of the stator winding does not vary appreciably, the d-c resistance value of the stator winding is used for this approximation.

The value calculated may be modified by a constant to take care of the reduction in temperature due to heat being conducted by the stator iron.

Motor Accelerating Limitations

In most instances the stall time limit will be dictated by the rotor. The reason for this is that the rotor resistance at start will be considerably greater than the stator resistance in order to obtain normal starting torque characteristics.

The principal factors which will influence the application and design of a large induction motor from the standpoint of starting duty will be:

1. Speed torque characteristics of the load.
2. Speed torque characteristic of the motor.
3. Voltage at the motor terminals during acceleration.
4. Size of the WK^2 on the connected load.
5. Frequency of starting.

Speed Torque Characteristics

The characteristics of both the motor and load must be compared to be certain that at any speed up to full load, the motor torque is higher than the load torque. If the load torque equals the motor torque at any point below full load speed, the motor will stall at this point and fail to accelerate. Under this condition the motor will rapidly overheat due to the high currents (of the order of 5 times full load) experienced over most of the accelerating period.

The designer must compromise the motor speed torque characteristics in such a manner as to give generally desirable running characteristics (efficiency and power factor), reasonably low starting current, and yet sufficient torque at every speed to insure break-away and prevent stalling. Having achieved this, the designer must check to be sure that in accelerating the connected WK^2 the rotor and stator will not overheat during the starting period. Within reasonable limits, the designer can adjust his design to meet the particular application conditions of acceleration and still meet the overall characteristics desired.

Due to the acceleration of the total WK^2 of the rotor plus its connected load WK^2 there is a certain amount of I^2R loss dissipated in the rotor. Additional losses will be present if there is load torque delivered through the shaft during this period. In the case of a wound rotor motor most of this loss will be dissipated in its external resistance. In the case of the squirrel cage winding all this loss is internal rotor I^2R loss.

The power delivered to the rotor of the induction motor is $T_m W_s$ where T_m = torque output of motor plus windage and friction, and W_s = synchronous speed of the motor.

The power loss in the rotor during acceleration will be equal to the power delivered to the rotor $[T_m W_s]$ less the power required to accelerate the load inertia and less the power delivered to any connected load during load acceleration.

$$\text{Power loss in rotor} = T_m W_s - T W_\alpha - T_L W = T_m (W_s - W)$$

W_α = Instantaneous rotor speed

$T_\alpha = (T_m - T_L)$ = torque for accelerating total WK^2 of motor plus load.

T_L = Load torque

Total energy loss in rotor during acceleration =

$$\int T_m (W_s - W)\, dt$$

The total inertia I is accelerated in accordance with

$$T_\alpha = I_\alpha$$

$$T_m - T_L = I \frac{dW}{dt}$$

$$dT = dW \frac{I}{(T_m - T_L)}$$

$$\text{total energy loss in rotor} = I \int \frac{T_m}{T_m - T_L} (W_s - W)\, dW$$

This integral can be expressed in terms of slip S of the induction motor.

$$\frac{W_s - W}{W_s} = S$$

$$W_s - W = W_s S$$

$$-dW = W_s\, dS$$

$$dW = -W_s\, dS$$

$$-I \int_{S_1}^{S_2} \frac{T_m}{T_m - T_L} W^2_s S\, dS = \text{total energy loss in rotor}$$

$$-IW^2_s \int_{S_1}^{S_2} \frac{T_m}{T_m - T_L} S\, dS = \text{total energy loss in rotor}$$

If there is zero load torque the value of this integral then becomes, for acceleration from S = 1 to S = 0:

total energy loss = $\frac{1}{2} IW^2_s$,

loss in kw secs = $0.232 \times WK^2 \times \left(\frac{\text{sync rpm}}{1000}\right)^2$

where WK^2 is expressed in (lb-ft)^2

Table of Load WK^2 for Polyphase Squirrel-cage Induction Motors, Larger Than 200 hp Rating

The following table lists load WK^2 which standard polyphase, squirrel-cage motors, larger than 200 hp, having locking rotor torques equal to 60 per cent of the full load torque and a rated temperature rise of 40 deg C, can accelerate without injurious temperature rise under the following conditions:

1. Rated voltage and frequency applied.

2. During the acceleration period, the connected load torque shall be equal to, or less than, a torque which varies as the square of the speed and is equal to 100 per cent of full-load torque at rated speed.

3. Two successive starts with the motor at ambient temperature, or one start with the motor not exceeding rated temperature. Subsequently, the number of possible starts will depend upon the time required to accelerate the load from standstill to full speed, the thermal capacity of the motor and the time required for the motor temperature to return to rated temperature after each start.

HP Rating	Speed, Rpm											
	3600	1800	1200	900	720	600	514	450	400	360	327	300
	Load WK^2 (Exclusive of Motor WK^2)											
250	229	1235	3185	6480	10900	16950	24350	33650	44600	57500	72400	39100
300	263	1390	3680	7340	12540	19500	28150	38750	51400	66200	83400	102500
350	298	1585	4165	8310	14200	22100	31850	43850	58200	74900	94400	116000
400	333	1755	4650	9270	15850	24650	34500	48950	64900	83600	105300	129500
450	367	1940	5130	10240	17500	27200	39250	54000	71700	92300	116300	143000
500	402	2120	5620	11200	19150	29750	42950	59100	78400	101000	127200	156400
600	472	2490	6590	13140	22450	34900	50400	69400	92000	118500	149300	183500
700	541	2855	7550	15070	25750	40050	57800	79600	105500	135900	171200	210400
800	610	3220	8520	17000	29050	45200	65200	89800	119000	153400	194200	237500
900	680	3590	9490	18940	32350	50300	72600	100000	132500	170800	215000	264500
1000	750	3950	10450	20860	35650	55500	80000	110100	146000	188200	237000	291500
1250	923	4870	12870	25700	43900	68300	98500	135600	179800	231700	292000	359000
1500	1095	5780	15300	30500	52150	81000	117000	161100	213600	275300	346600	426500
1750	1270	6700	17220	35360	60400	94000	135500	186700	247500	319000	401700	494000
2000	1440	7620	20130	40400	68700	106700	154000	212000	281400	362500	456500	561000
2250	1615	8530	22550	45000	76900	119600	172500	237600	315000	406000	511500	629000
2500	1790	9450	25000	49850	85200	132500	191200	263000	349000	449500	566000	696000

and is the total WK^2 of the motor plus load.

This integral indicates that to accelerate a given WK^2 the energy which goes into the heating of the rotor is independent of the total time required for acceleration. The effect of load torque (T_L) increases rotor heating. If load torque is present the acceleration loss may be evaluated by assuming a constant value of T_m and T_L for an increment of the accelerating period and then evaluating this integral between the slips chosen.

$$\text{kw secs.} = 0.232 \times WK^2 \times \left(\frac{\text{sync rpm}}{1000}\right)^2 \times (S_1^2 - S_2^2) \times \frac{T_m}{T_m - T_L}$$

Reduced voltage decreases motor torque T_m as the square of the terminal voltage. If the voltage reduction is appreciable there is danger of the motor sticking at some point below the maximum torque during the accelerating period. Reduced voltage starting also increases motor heating as $(T_m - T_L)$ is decreased. An example of the temperature rises of the rotor and stator of a large induction motor for a full and reduced voltage acceleration is given in Fig. 1.

Stator Heating

The heat loss in the stator of an induction motor during the accelerating period will be $\int I_1^2 R_1 \, dt$. This loss is evaluated by plotting a curve of current vs time and then integrating the I^2R loss for each period of time over the entire accelerating period.

The stator heat loss increases with the length of the accelerating period and may limit the motor particularly on long accelerating cycles. It is not unusual to find stator limited motors on such applications as large fan drives requiring accelerating periods of the order of 40 to 60 seconds.

The safe temperature rise of the stator and hence the safe accelerating period may, of course, be increased by using higher temperature insulations, however, it should be remembered this expedient is only satisfactory if the rotor temperature still remains within reasonable limits. High temperature motors which are physically smaller than Class A machines usually have less rotor thermal capacity and, therefore, for the same nameplate horsepower they have less capacity for accelerating a given WK^2 than Class A motors.

Frequency of Starts

It is extremely important that the number of accelerations required within a given period be clearly defined at the outset for the motor's application. Too frequently, during the life of large induction motors, they may be started several times in succession without allowing sufficient time for the motor temperature to decrease to a safe temperature before the next start.

The initial acceleration of the motor on a high WK^2 start such as an induced draft fan drive may bring the motor to its safe temperature limit. Starting the motor immediately after such an initial start could cause some permanent damage to the motor.

In order to insure proper application of induction motors in sizes 250 hp and larger on drives with large WK^2 loads NEMA has adopted the values shown in the accompanying table, showing load WK^2 vs hp for various synchronous motor speeds. Besides defining the size WK^2 which standard 40 C rise induction motors can accelerate without injury it indicates the time interval for successive starts as far as possible.

Where applications require the acceleration of higher WK^2 than those given special motor designs will generally be required. This means that the thermal capacity of the rotor cage must be increased by increasing its physical size and therefore the motor is in essence larger than that required for its rated horsepower.

As WK^2 increases appreciably above the values given and frequency of accelerations increase the wound rotor motor should be considered for the application.

Conclusions

1. Under stalled conditions a large induction motor is generally limited by reaching its maximum safe rotor temperature before its maximum safe stator temperature.

2. Safe stall time for large induction motors depend upon the particular motor design and are of the order of 4 to 20 seconds for induction motors of from 4000 to 250 hp.

3. For a given connected WK^2 and no load torque, rotor heating is independent of accelerating time.

$$\text{kw sec loss} = 0.232 \times WK^2 \times \left(\frac{\text{sync rpm}}{1000}\right)^2$$

where WK^2 is expressed in lb-ft.

4. The effect of load torque is to increase rotor heating during the accelerating period in accordance with:

$$\text{kw sec loss} = 0.232 \times WK^2 \times \left(\frac{\text{sync rpm}}{1000}\right)^2 \times (S_1^2 - S_2^2) \times \frac{T_m}{T_m - T_l}.$$

The effect of reduced voltage accelerations is to increase the heating and increase the possibility of the motor sticking at some speed below maximum torque.

5. The stator energy loss during acceleration is largely determined by the length of the acceleration period and is equal to $I_1^2 R_1 dt$.

6. The maximum safe temperature rise of the stator may limit the rotor during acceleration on long acceleration applications.

7. The NEMA table defining safe load WK^2 for given horsepowers and speeds represents a basis of good application. Departures from this may be considered special designs and the application of wound rotor motors should be considered.

8. Complete motor protection requires protection for stalled conditions and during the accelerating period as well as at moderate running overloads. Careful consideration should be given to such protection.

TV Monitor Saves $10,000 a Year

USING A CLOSED-CIRCUIT television system, an industrial firm estimates it saves $850 each month in electric bills.

That company, a manufacturer of zinc oxide products, is billed by the electric power company with a type of billing, used with many industrial concerns, involving a maximum demand charge. This means that the electric bill for the month is based on the peak load used during this period, even if this peak occurs for just an instant. This method is used because the power company has had to install power lines and generating equipment capable of handling the peak loads of the manufacturer.

If the manufacturer can monitor the demand meter, he will be able to control his power consumption by switching electric furnaces so that peak power demands far above the average could be avoided. (See POWER ENGINEERING, January 1957, page 74.)

Fig. 1. Engineer in manufacturing plant's control room observes this TV picture of demand meter 500 ft away in sub-station. He controls electric furnaces and other equipment to keep the maximum power demand below limit

Fig. 2. At power company's sub-station, supplying electric power to manufacturing plant, this television camera, circled by neon-light tube, views demand meter. Picture of meter is transmitted to monitor of Fig. 2 in the control room of the manufacturing plant

Because the power company does not permit tapping onto the demand meter for remote indication, and because placing a man in the power company's sub-station for monitoring is both impractical and expensive, a small, 5-lb TV camera, Fig. 2, is mounted to furnish a close-up view of the meter. Some 500 ft away in the plant control room, an engineer watches the meter reading on a TV monitor, Fig. 1, and makes the necessary load adjustments to keep the demand from exceeding specified limits. The manufacturer, with an investment of only $4000 in an industrial TV system, now enjoys a saving of over $10,000 annually.

For more detailed information about this TV equipment, write the Editor, or jot Demand Monitor on the prepaid return post card elsewhere in this issue.

Fig. 1. Wall deslagger (left) and retractable blower showing a section of its rugged framework which supports the overhung weight of the lance when in the extended position

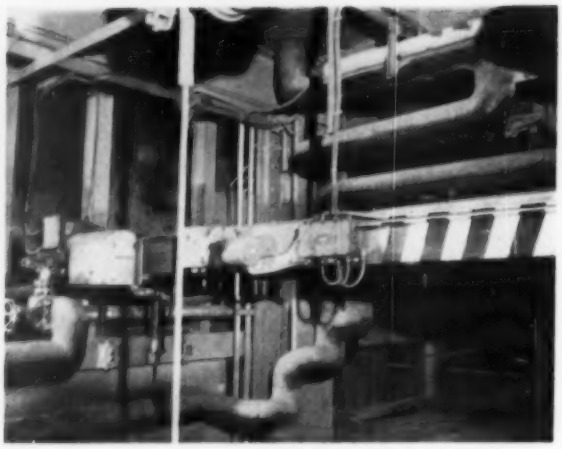


Fig. 2. Four of these retractable soot blowers take care of wide spans in Unit 2. Two driving motors produce double multi-helix cleaning path to cover different areas of tube

Soot Blowers Give Cromby Broad-Range Steam Temperature Control

BROAD-RANGE regulation of steam temperature is the job of soot blowers on Boiler Units 1 and 2 at Cromby Station of Philadelphia Electric Co. Vernier control is then handled by gas recirculation, biasing superheater and reheater dampers, and by spray desuperheaters on Unit 1; and by tilting burners, desuperheater sprays, and by biasing the firing rate to the superheat or reheat furnaces on Unit 2.

Design of both boilers is such that all walls are formed by tangent tubes, which eliminate refractory surfaces, but introduce large steaming areas that must be kept free of slag. This cleaning is done by Vulcan automatic wall deslaggers, Fig. 1. The remaining surfaces, superheaters, reheaters, air heaters, etc. are cleaned by Vulcan long retractable soot blowers, Fig. 2, having travel extensions from 18 to 28 ft.

Blowers for each boiler are connected to Copes-Vulcan automatic-sequential control panels, Fig. 3, in the plant control room. Both controllers are complete with indicating lights, control switches, interlocks, annunciators and means for setting up continuous blowing programs.

Annunciator lights on the panels indicate to the attendant the progress of the blowing sequence. The program of blowing sequence can be switched to manual control, stopped, changed or started at will, depending on operating conditions at the time.

Boiler Unit 1, built by Babcock & Wilcox, is of single-drum, radiant, pressurized, dry-bottom design for pulverized coal or oil firing. It has a continuous output of 1,050,000 lb per hr at 1875 psig and 1000 F. Reheat is from 630 F to 1000 F. Practically all the heating surface is contained in the furnace and, to reduce over-all dimensions, part of the surface is included in a wall which divides the furnace into two equal parts. Steam from this unit goes to a General Electric turbine generator having a nameplate rating of 150,000 kw, maximum capability of 165,000 kw.

Unit 2 is a single-drum, controlled-circulation, dry-bottom, radiant twin-furnace, tangential-fired type built by Combustion Engineering, Inc. Here, too, most of the boiler heating surface is contained in the furnace, which operates under conventional balanced conditions. Continuous output is 1,450,000 lb per hr at 1875 psig and 1000 F. Reheat is from 620 to 1000 F. It supplies steam to a Westinghouse turbine generator with nameplate rating of 200,000 kw and maximum capability of 220,000 kw. This is the first generator of its size to have inner cooling of stator and rotor.

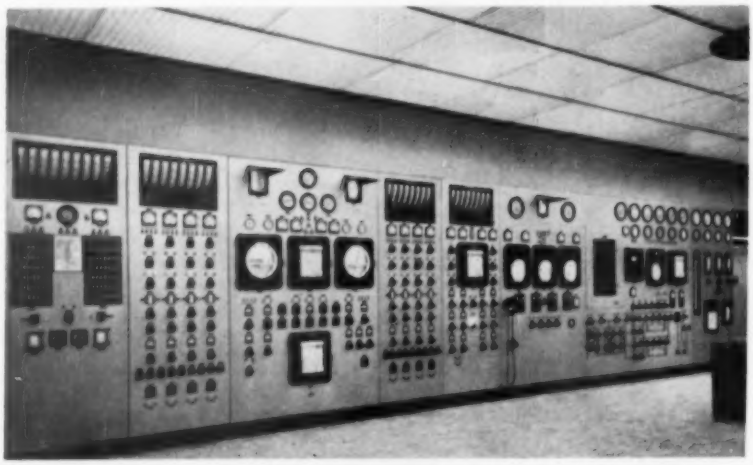


Fig. 3. View of the automatic-sequential control panel for soot blowers (extreme left) shown built into main control board for Boiler Unit 2 at Cromby Station

Turbine Business: Barometer of Future Economic Health

FORECASTS recently made by "the prophets of economic doom" were challenged by Armand T. Chandonnet, general manager of the company's Medium Steam Turbine, Generator and Gear Department, Lynn, Mass. He said that a *tremendous upsurge* in the power-generating apparatus and marine propulsion equipment field refutes to-day's economic pessimists.

"Our business," Chandonnet said, "is one of the best barometers of the future economic health of the nation, and our business is at an all-time high. The prophets of economic doom have evidently overlooked this important business indicator."

He said his own department's scheduled output both for 1957 and 1958 will be close to 60 per cent higher than last year's record peace-time output.

"Our experience in this power generation field over many years has proved that the turbine generator business is extremely sensitive to national economic trends," he declared. "An increase in our business volume usually foreshadows an increase in industrial expansion nationwide."

When the basic industries are optimistic in planning expansion, "it is generally reflected in our barometer turbine business — one, two or three years before this expansion shows in the gross national product.

"Because our manufacturing cycle is long — a year or more — our turbine business is an accurate indicator of future growth in the basic industries we serve," he continued.

Chandonnet stated that the Medium Steam Turbine, Generator and Gear Dept. has recently concluded its best peacetime year of production, has its largest peacetime employment and currently is in the process of a planned capital expansion program for 1957 amounting to $9,000,000.

To meet this anticipated upsurge in business, the department is currently building a new $2,000,000 manufacturing bay where the machining, assembling, and testing of turbines, generators and gears will be performed. The building is to be completed this spring and will be equipped with a 200-ton crane capacity to permit production of turbine-generator units larger than any now made in Lynn.

In addition to these major projects a number of other manufacturing and office areas have been renovated and modernized, he said. The department has had to purchase a number of new machine tools and other types of equipment to enable it to meet the rapidly expanding production requirements, he said, and cited as an example of these purchases a custom-designed horizontal boring mill which will be delivered in November and will cost $800,000.

Training expenses connected with the expansion program are expected to amount to $550,000 this year alone.

He pointed out that the department recently invested another $1,000,000 in a new materials and processes laboratory.

In addition to the $9,000,000 to be spent this year for expansion Chandonnet pointed out that his department spent $5,000,000 during 1956. This, he said, is part of the over-all company's planned expenditure of $500,000,000 on capital expansion for 1956–1958. Chandonnet pointed out that General Electric Company has invested nearly $1,400,000,000 in new and modernized facilities since the end of World War II.

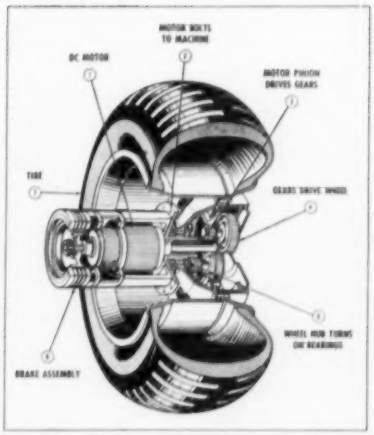
R. G. LeTourneau Inc To End Name Mix-Up With LeTourneau-Westinghouse Co

WHO MAKES LeTOURNEAU equipment? This question appears to puzzle many of our readers, and now that R. G. LeTourneau Inc has recently announced plans to reenter the earth-moving field, it is a good time to clarify this confusion.

Let's go back to the beginning. Robert G. LeTourneau was a pioneer in the field of heavy equipment. He developed the two-wheel tow unit with extra-large rubber tires and the familiar Carryall, now a widely-used type of equipment for coal handling. These machines, plus other heavy earthmoving units, were marketed with the names "LeTourneau" or "LeT" as trademarks.

In 1953, LeTourneau sold the earthmover part of the business to Westinghouse Air Brake Co. which began manufacturing and marketing this equipment under the name "LeTourneau-Westinghouse Co." At the time of the sale, it was agreed that R. G. LeTourneau Inc would refrain from building earthmoving equipment for a period of five years and specifically refrain from using the trademarks *LeTourneau* or *LeT* on such equipment.

After leaving this phase of the business in 1953, LeTourneau continued manufacturing and developing other types of extra-large equipment for such fields as land-clearing, off-road transportation, logging, heavy materials handling, offshore drilling, and other fields not related to earthmoving. These large units continued to carry the LeTourneau name and thus some confusion arose in the public mind regarding the difference between LeTourneau and LeTourneau-Westinghouse.



Cutaway view of R. G. LeTourneau Inc design of an electrically-powered wheel

It has now been announced that R. G. LeTourneau Inc will return to the earthmoving field in 1958 when the 1953 agreement with Westinghouse expires. The new line of equipment will be marketed under a new trademark — *AR-GEE* — instead of the former *LeT* or *LeTourneau*. The name *AR-GEE* obviously is derived from the initials, R. G., in the company name.

A feature of the new earthmoving equipment to be introduced in 1958 is the so-called Electric Wheel. This drive has been used in other LeTourneau products and consists of a d-c electric motor and gear train in each wheel powered by diesel-driven generators. Engines up to 600 hp are used to drive the generators and power the wheel motors. The accompanying illustration shows a cutaway view of the wheel, gear train, and motor. This system can provide driving power on all wheels of a given vehicle.

Calibrate Meters Easier—It's Smarter

Use of a precision dial manometer mounted on a portable cart combined with the use of a head tank and air supply has made the calibration and testing of power station meters and instruments much easier at the St. Clair Station of the Detroit Edison Co. Aside from its simplicity, the method is more accurate than methods previously used

AT THE ST. CLAIR generating station of The Detroit Edison Co, the Instrument group recently put into use an easier method for calibrating flow meters, liquid level meters, draft gages and similar instruments installed in various parts of the station. As described in a recent issue of *Coal to Kilowatts* by L. M. Taylor, this method is an adaptation of a similar method used at the Philip Sporn plant of the American Gas and Electric Co.

During a visit to Philip Sporn Station by the technical personnel of St. Clair, it was observed that calibration tests were made with all the test apparatus mounted on a small portable cart. The use of this cart seemed like a good idea and it led the St. Clair engineers to revise their methods of instrument calibration.

All of the instruments involved operate on a differential pressure principle, the pressure varying up to a value as high as 212 in. of water. Before the new method was used, when calibrating such instruments, it was often necessary to set up manometer legs extending through a double ceiling and the two floors above. Telephones or other means of signalling were required during the test operations and considerable difficulty was encountered when applying the desired head calibration head pressure to the instrument.

The reading of the manometer was impossible at in-the-floor levels and when this condition prevailed a resetup of the test apparatus became necessary. Density corrections were also difficult to apply to the long leg manometer fluid because of varying temperatures at different elevations.

Eliminates Climbing

The new method eliminates practically all climbing during the calibration operations because it makes use of a Wallace & Tiernan precision dial manometer with a head tank and air supply. Aside from its inherent simplicity and accuracy, the new method greatly reduces accidents due to falling or accidental burns from hot piping and tubing.

Figure 1 shows the principles involved in the system. The head tank is actually two tanks, each with a large horizontal cross section; one opened to atmosphere, the other closed. Both have sight glasses as shown. The open tank is connected to the low pressure side of the meter being calibrated. The closed tank is connected to the high pressure side of the meter and to the precision dial manometer. Both tanks are located above the meter to permit easy venting of entrapped air from the rubber lines to the meter during the hook-up. The height of the head tank with respect to the meter is unimportant as long as entrapped air is eliminated in the lines between the meter and the head tank.

Details of Operation

Prior to the actual test, the water level in the two tanks, and the heads on both legs of the meter, are equalized by the aid of the sight glasses. The tank equalizing valve is then closed and the closed head tank pressurized by air measured by the precision dial manometer to give the desired calibration head. Different head pressures can be applied to the system by valves on the test cart covering the complete range of the meter to calibrate it conveniently and accurately.

For convenience, the precision dial manometer is mounted on the portable cart together with, 1), two valves for applying and releasing the air pressure to the closed tank; 2), a mercury manometer used as a relief valve and rough double check on the precision dial manometer; and, 3), a pressure regulating valve for limiting the air pressure on the test system.

With regard to the head tank hookup to the high and low pressure leg settling chambers, there is a Bailey Meter Company vent valve in each leg at an elevation higher than the meter between the meter and the settling chambers. These vent valves are not shown in the diagram. By cutting out the flow meter at the settling

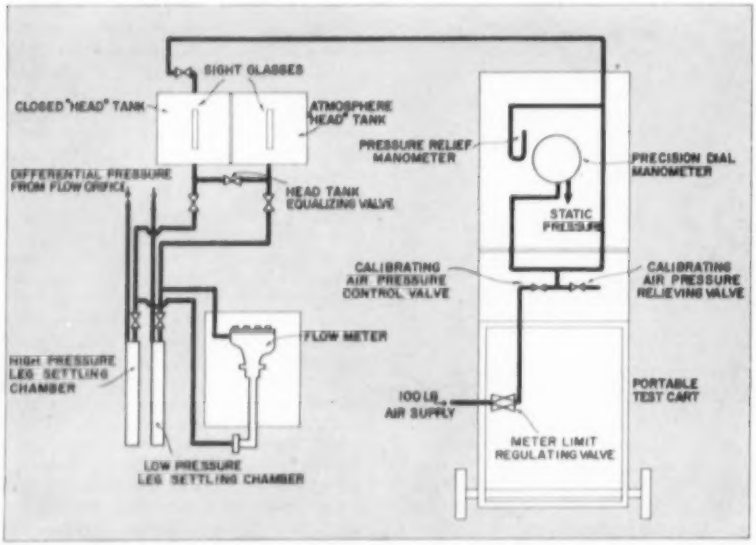


Fig. 1. Simplified flow meter calibration system as it is used at St. Clair plant

Fig. 2. Instrument man, John Arnold, makes calibration check of flow meter with the precision dial manometer mounted on portable cart

Fig. 3. Rear view of portable test cart on which are mounted the calibration air pressure control and measuring equipment as described in the text

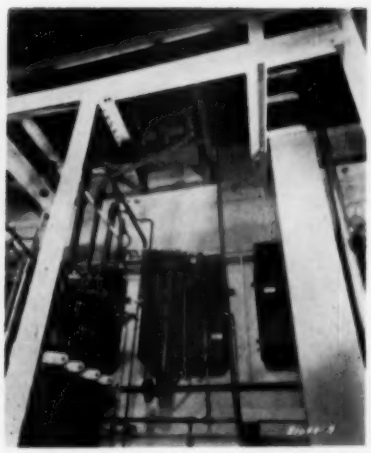


Fig. 4. Head tank in place at the top of picture and lined up to the flow meter being calibrated through settling chambers shown at lower left

chambers and equalizing the leg pressures by opening the meter equalizing valve, the vents can be opened and their valve stems removed. The rubber water-filled hoses from the head tanks are then slipped over the vent valve bodies thus completing the test equipment hook-up.

The Wallace & Tiernan precision dial gage used in this set-up has an 8½-in. dial with a 45-in. scale in two revolutions. Ranges run from 0 to 120 in. of water, minimum and 0 to 300 in. of *mercury*, maximum. It has a sensitivity of 1/10,000 in all ranges.

This system of calibration has given excellent results at St. Clair Station and some of the other plants in the Detroit Edison system have adopted it, some with various modifications.

Gas-Steam-Turbine Plant Will Use First Unified Design

MAN'S untiring efforts to get more "muscle power" out of heat and other energy that might ordinarily go up the chimney will receive a practical demonstration when the Crisp County Power Commission's new generating plant Crisp goes on the line in March, 1958, at Warwick, Ga.

For the plant, The Babcock & Wilcox Co. has developed a waste heat and power boiler to be used in a system in which pressure heat and unburned oxygen exhausted from a simple-cycle gas turbine will be used to help generate steam and drive a second turbine. While several power stations are using gas turbine-steam turbine cycles for greater fuel efficiency, this installation will be the first time such a system has ever been designed from the start as a combined operation.

Steam boiler itself will burn pulverized coal, natural gas, or oil. Exhaust from the gas turbine will flow to the boiler at 840 F, and will assist the boiler in reaching the high temperatures required to convert 130,000 lb of water to steam every hour. In addition, the gas turbine exhaust will be put to work on other jobs on the steam boiler, including drying and transporting coal for two B&W pulverizers, and heating feed water by an economizer.

The combination gas turbine-steam turbine plant will be the Power Commission's first use of steam for generating electricity on a large scale. When operated as a combined cycle, the efficiency of the combination plant is well above the average of the conventional steam operated plant of comparable size. Also, when operated in combination with the utility's hydroelectric plant, the efficiency will still be greater, resulting in lower generating costs per kilowatt-hour.

Flexibility of the electric generating system will insure dependable low cost power at all times, whether operating as steam turbine, or gas turbine, or with hydroelectric units, or combinations thereof.

Air-Cooled Aluminum Bus for Haas Underground Plant

BUSWORK and switchgear for the first major underground power plant in the United States — Pacific Gas & Electric Co.'s 150,000-kva Haas Power Plant on the Kings River in central California (see January issue, page 61) will be supplied by G-E's high-voltage switchgear department.

The Haas Powerhouse will be located in rock chamber 500 ft vertically below the surface, and 2,000 ft into the mountain from the river. It will require a vertical run of bus — an aluminum bar which carries an extremely high current of electricity — running through 462 ft of rock from generators underground to transformers at the surface.

Forced-air cooling will be provided with the vertical bus duct, eliminating the installation of heat barriers every 50 ft, and solving the problem of temperature gradient on the long rise.

Forced-air cooling will also reduce the size of the bus duct, an important factor since space in the vertical shaft will be at a premium.

In some cases in Europe, protection from bombing, avalanches, or snowslides has been the reason for location of underground power plants. In the case of the Haas plant, however, the location involves economics. It will reduce the penstock cost and produce more power than a surface unit under the conditions existing at the site. Transformers will be located at the top of the gorge because it would be impractical to place them underground, and unsafe to run transmission lines up through a shaft.

Aluminum, isolated-phase bus duct and switchgear will also be furnished for three other new PG&E power stations scheduled for 1958.

The other three are the 108,000-kva Balch Powerhouse, also on the Kings River, and the 122-000-kva Caribou No. 2 and the 40,000-kva Butt Valley powerhouses on the Feather River in northern California.

How To Measure Small Amounts Of Silica in Feedwater

Presence of silica in feedwater is easy to determine when you have lots of it present—but suppose there's only about 0.005 ppm in your sample; can this be measured accurately? Author explains how

By S. ALFANO*

ONE QUESTION often asked by skeptics is that about how *sure* is the chemist that water contains such small amounts of constituents. Exactly how accurate is the analysis? Is he sure that 0.005 ppm is actually the amount and not more nor less?

These questions pose doubts; the writer must confess that he also entertained such doubts in the past.

To measure accurately such small quantities, a superior spectrophotometer is a must. The following is the technique which the writer recommends:

Silica shall be determined in accordance with the latest Armour Institute Method as described in ASME paper No. 51-A-92, with some modifications as presented here. The Beckman Model B spectrophotometer may be used in lieu of the Model DU. (The spectrophotometer shown in Fig. 2 is in use at the laboratory of the water conditioning section, Allis-Chalmers Mfg. Co.) †

Prepare Test

Warm up instrument. Prepare transmittancy curve for known concentrations of silica from 0.0 to 0.20 ppm in the following manner:

Clean 50 mm absorption cells with chromic acid. Rinse and fill with distilled water, or better, from freshly collected condensed steam sample from a boiler, the water content of which has SiO_2 below 1.0 ppm and operating below 900 psia. Collect 20 liters of such steam condensate; it shall measure 2 or more megohms in resistivity, and will have a silica content below 0.002 ppm.

1. Fill the 50-mm Corex absorption cells with this water.
2. Adjust wave length to 815 mu.
3. Adjust dark current knob for zero transmittance.
4. Adjust slit to smallest aperture. Open shutter.

Observe deflection at sensitivity of 1. If deflection is between 50 and 100 per cent transmittance, open slit until the deflection reaches 100 per cent. The slit should not be opened greater than 20 per cent.

The instrument is now set to read 100 per cent transmittance when the light beam passes through the 50-mm Corex cell filled only with pure distilled water containing no extraneous color source.

Now add the reagents (which effect the blue color when the silicomolybdate complex is reduced with the amino reducing agent) — in reverse order, without the hydrochloric acid — to a 100 ml of this pure water. Place in Corex absorption cell and read transmittance. The deflection will still be 100 per cent, indicating the reagents contain no color, nor light absorbing constituents. Now add the hydrochloric acid and repeat.

Check Reagents

Having established the purity of the reagents in regards to presence of color material, it is now time to establish the silica contamination in the reagent chemicals themselves.

To establish the amount of silica adulteration of the reagents, proceed as follows:

Place 100 ml, 99 ml, 98 ml, 97 ml, 96 ml, respectively, into each of five plastic beakers.

Add 1 ml of hydrochloric acid (1:1) and 0.2 gm of dry ammonium molybdate by means of a measuring spoon to the 100 ml of pure water.

Add 2 ml of acid and 0.4 gm (two spoons) to 99 ml sample.

Add 3 ml of acid and 0.6 gm (three spoons) to 98 ml.

Add the same incremental amounts until all five samples have been treated. Proceed with the addition of oxalic acid after 5 minutes, and with the amino reducing agent soon after the oxalic. Then let stand 5 minutes and read the transmittance.

Using the same source of pure distilled water and varying amounts of reagents there will be noted a progressively decreasing transmittance reading.

A typical run for a batch of reagents is shown in the table.

This test establishes the extent of contamination which the reagents contribute to the analysis. Thus as a blank, the reagents contribute 5.5 per cent absorption.

Now, instead of adjusting the distilled water blank to 100 per cent transmittance, turn the slit until the deflection reads 105.5 per cent. This position compensates for the silica component which the reagents introduce in the analysis.

It is now time to prepare a standard silica curve showing silica concentration plotted against transmittance.

To this same water in the original 20 liter plastic bottle make known concentrations of 0.0, 0.005, 0.010, 0.015, 0.020, etc. ppm silica. Proceed with the addition of 1 ml HCl (1:1), 1 spoon (0.2 gm) MoO_3; wait 5 minutes, then add 2 ml of 10 per cent oxalic acid; shake, then add 1 ml of the amino reducing reagent; wait 5 minutes and then read transmittance.

Using a 50-mm absorption Corex cell the following readings were obtained and plotted on semilog paper:

SiO_2 ppm	Transmittance, per cent	
0.00	105.5	no reagents added
0.00	100.0	reagents added
0.005	97.0	reagents added
0.010	94.6	reagents added
0.015	92.0	reagents added
0.020	89.6	reagents added
0.030	85.0	reagents added
0.040	84.0	reagents added
0.050	76.2	reagents added
0.060	72.2	reagents added
0.100	58.5	reagents added
0.150	45.0	reagents added

These data establish the standard plot on which future analyses are resolved, provided the instrument has not lost sensitivity, nor has the photoelectric cell deteriorated to the point that slit opening must be increased. The lamp for the light source should be replaced in time.

An additional precaution is taken so that all doubt is eliminated. A 20 liter plastic bottle filled with water,

† See: How To Identify Steam-Water Cycle Deposits, POWER ENGINEERING, February 1955 issue.

* System Plants Chemical Engineer, Houston Power & Lighting Co.

Sample ml	HCl ml (1:1)	MoO_2 spoons	Oxalic ml	Amino ml	Trans. %
100	0	0	0	0	100.0
99	1	1	2	1	94.5
98	2	2	2	1	90.5
97	3	3	2	1	86.0
96	4	4	2	1	81.0

Table shows a typical run for a batch of reagents

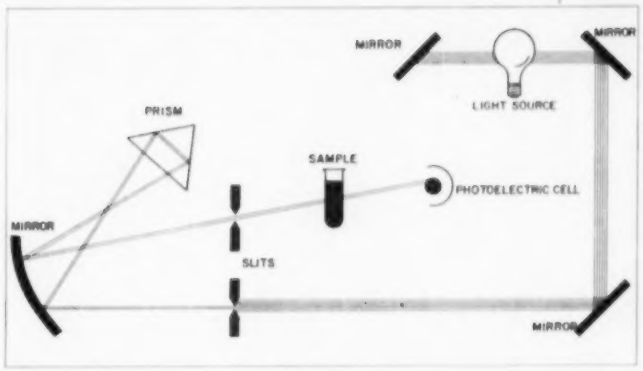


Fig. 1. Schematic diagram of spectrophotometer theory of operation

the purity of which has been established, is used to supply a referee sample. For the next 200 analyses there will always be taken a 100 ml sample from this bottle and analyzed with the rest. Its transmittance is logged onto the plastic bottle. The date and quality is written on it with wax pencil. Any deviation is promptly suspect. In the course of this survey this water has shown constancy, adding conviction to the analysis and the findings on the demineralizer effluent. The constancy of this referee sample has been astounding beyond belief.

Reagents

a. Hydrochloric acid (1:1); dilute strong acid (sp gr 1.19) with equal parts of silica-free water. This reagent is silica free and does not pick up any silica from glass, but recommend plastic bottle.

b. Ammonium Molybdate (10 per cent); dissolve 10 gm of the salt in 90 ml of silica-free water. The silica and phosphate interference derive from this reagent. As an alternate, measure the dry crystals in a measuring spoon holding exactly 0.2 gm of the salt. This measurement must be exact at every analysis.

c. Oxalic acid (10 per cent); measure dry in a spoon holding 0.2 gm crystals.

d. Amino reducing agent; dissolve 0.5 gm of 1-amino-2-naphthol-4-sulfonic acid powder and 1 gm sodium sulfite in 50 ml distilled water; then add to a previously prepared solution of 30 gm sodium bisulfite in 150 ml distilled water.

e. Sodium silicate standard solutions; procure standard silica solution from reliable sources from which dilution to other concentrations may be effected.

Place 100 ml of sample in a plastic bottle. Add 1 ml HCl acid; add 1 spoon of molybdate crystals (0.2 gm); wait 5 minutes after which add 1 spoon oxalic acid crystals; shake and then add 1 ml of amino reducing agent. Let stand 5 minutes and then determine transmittance. In every case where dry crystals are added a solution of them should be secured.

As an aside, but of particular interest to the industry, the writer presents here a report of silica prevalence in the steam-water cycle.**

Silica Key Component

Silica is admittedly the key component of all the constituents that lead to trouble in a steam generating plant. Its presence in the cycle is a function of its concentration in the boiler. For the 1500-psi parameter, the silica dissolved in the steam has been found to be 1 per cent of its concentration in the boiler water. This is in very close agreement with the findings of Straub.

In correlating silica prevalence in the steam-water cycle with its concentration in the boiler water, the disturbing discovery was made that the standard steam sampling device did not so confirm this relation.

Present Standard Inadequate

Regardless of the silica content in the boiler water, the steam sample taken from the standard sampling probe in the boiler drum did not vary; while the silica in the high pressure heater traps, boiler feed, and exhaust condensate varied proportionally. It is evident that the present standard is inadequate to reveal the true performance of a steam generator. A better sampling point is the drain from the highest pressure heater, from which approximately 5 per cent of the steam flow is extracted. While some may reason that the sample may have entrainment removed within the first group of stages in the machine, the writer feels that the temperature in this zone precludes such possibility.

Fig. 2. Spectrophotometer determines silica in samples from calibration curves

** See: Webster Plant Uses Manual Operation on 2-Step Mixed Bed Demineralizer, POWER ENGINEERING, March 1957 issue.

New Control Takes Guess-Work Out of Tube Expanding

DIAL incorporated into the Model C Torq-Air-Matic, a new air-powered tube-expander drive and control, is intended to provide the control necessary for precise boiler-tube rolling. The operator has but to set the desired torque (in foot-pounds) on the dial and start the rolling operation; when the desired torque is obtained, the expander automatically stops rotating.

Joint tightness is always uniform, it is claimed, regardless of tube-sheet hole variation. Guesswork is taken out of tube expanding because the operator does not have to depend on expander resistance, motor sound, or "feel", to determine correct expansion. This feature makes the tool easy to use, even by untrained personnel, and eliminates over- and under-rolling.

The Model C is designed for a wide range of boiler tubes, from 1 to $2\frac{1}{2}$ in. O.D. Similar in principle to the Model A Torq-Air-Matic, the new model produces 75 ft-lb of torque, powerful enough to roll 3-in. No. 10-gage tubes in a $\frac{5}{8}$-in. thick sheet. It is a completely integrated one-piece device. With an air hose as the only external connection, the unit is not cumbersome, and there are no delicate auxiliary parts that might be broken.

Precise tube expanding eliminates useless over-rolling and cold-working of metal to destruction. Tube ends are not excessively thinned and there is no problem about the probability of "leakers." Precise expanding also means greater tube life and minimum axial pressure against tube sheets or drums.

The Model C weighs 26 lbs, has an over-all length of 18 in., and a free speed of 200 rpm. A quick-acting, snap on mandrel driver facilitates changing expanders.

For further information write the Editor, or jot Expander Control on the return post card elsewhere in this issue.

By setting the desired torque on dial of tube expander, operator rolls tubes easily and accurately

fold along this line—outside edges toward you

How the Wind Velocity Affects Heat Transmission Coefficients

By JOHN D. CONSTANCE

HEAT transmission coefficients used in heating and air conditioning load calculations are based on an outside wind velocity of 15 mph and still air (50 ft per min) on the inside surface. The familiar equation to determine the over-all coefficient U is, for a simple wall:

$$U = 1 \div \left(\frac{1}{f_i} + \frac{x}{k} + \frac{1}{f_o} \right)$$ Btu per hr per sq ft per deg F

where x is wall thickness in inches; f_i is film coefficient for inside air, k is conductivity of wall (Btu per hr per sq ft per in. thickness), and f_o is outside film coefficient (6.0 for 15 mph wind).

For a compound wall of several materials having thickness in inches of x_1, x_2, x_3, etc.

$$U = 1 \div \left(\frac{1}{f_i} + \frac{x_1}{k_1} + \frac{x_2}{k_2} + \frac{x_3}{k_3} \cdots\cdots\cdots \frac{1}{f_o} \right)$$

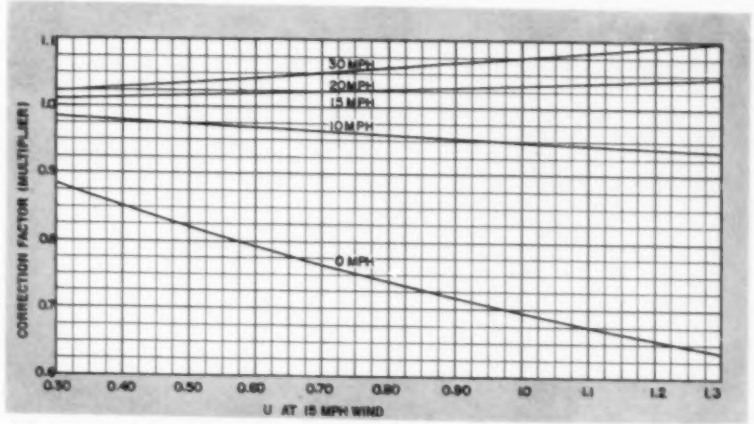
For air-space construction and multiple materials, an air-space coefficient for each space must be inserted in either of the equations.

In our discussion here, for any one wall type the only change will occur in f_o. For low values of U occurring in multiple and air-space types of construction, a change in f_o is not as effective as for higher values of U occurring in simple walls or single wall materials. See chart.

In order to give a quick visual indication of what happens when wind velocity changes, the accompanying chart has been worked up from data obtained from the Heating & Ventilating Guide (American Society of Heating and Air Conditioning Engineers). Coefficients U based on average wind velocity of 15 mph are plotted against correction factors (multipliers) for various wind velocities designated in the Guide. Above an average wind velocity of 30 mph, infiltration takes on a more important role in heating and air conditioning calculations.

Once knowing the 15 mph coefficient U, read up to the proper velocity curve and then left to read the multiplier. Then use it thus:

Corrected U = multiplier × U from chart.



Correction factor for coefficient U at various wind velocities. Corrected U = U (chart) × multiplier

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This Short Cut Pays Off In Turbine Operation

By a single stage-temperature measurement, you can discover internal condition and efficiency of a turbine

ONCE in a great while somebody comes along with an idea that makes sense. In this instance the idea had to do with an economical method of determining the internal condition of a turbine, which is directly related to the efficiency of the machine.

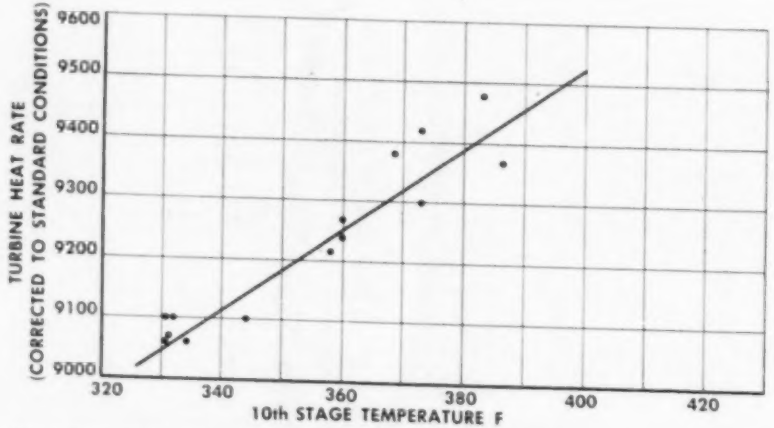
In the past it was necessary to install and make use of many instruments to obtain data on turbine performance. During the actual test, running usually from 30 minutes to two hours, the load is held constant while a team of six to seven men take readings of temperatures, pressures and flows.

The data are then processed by a technical group who calculate the efficiency of the machine. It is self-evident that this is a long, involved and expensive procedure.

A few months ago, according to John R. Madsen in *Coal to Kilowatts* of the Detroit Edison Co, the idea was conceived that there might possibly be good correlation between the turbine efficiency and steam temperature at some point along the steam path within the turbine. After examining records from tests for the past several years, it was found that a direct correlation existed between some of the extraction steam temperatures and actual heat rate. (See graph).

Now, all that is required to obtain an estimate of the condition of a turbine is to set the initial throttle and steam conditions to standard and read the extraction steam temperature. (The extraction point used is the one closest to saturation, yet still superheated.) Comparison with the graph of Extraction Steam Temperature vs Heat Rate for that turbine will give a good approximation of actual condition. Maintaining a chronological plot of these temperatures shows trends away from normal.

The Delray Technical Group assisted greatly in developing this procedure and have been using it since last August. Marysville started using it last November. The major use of this method is to determine the optimum time to wash the turbine to remove blade deposits. All evidence indicates it to be a very reliable close approximation of the turbine internal condition. It is almost unaffected by such variables as back pressure, cooling water temperature, and so on. Other plants are planning to start using this method in the near future.



Graph of extraction steam temperature related to turbine heat rate for No. 7 MTG at Marysville Station

POWER ENGINEERING HANDBOOK

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Inert Gas Welding Equipment Cuts Non-Ferrous Metals

AIRCOMATIC inert gas welding process, developed in 1948, can now be used for cutting non-ferrous metals in addition to welding ferrous and non-ferrous metals. Using standard Aircomatic welding equipment, this new process requires no special operator techniques. Simple adjustments in gas flow and steel wire speed are all that is needed. Both high production machine equipment and manual equipment can be adjusted for cutting with equal facility.

Aluminum, stainless steel, chrome steel, nickel, Monel, Inconel, copper, brass and aluminum bronze have been cut with a quality entirely satisfactory for subsequent welding operations. On ¼-in. plate, cutting speeds up to 132 in. per min can be attained on aluminum, and 85 in. per min on stainless steel.

Aircomatic welding employs a consumable wire electrode arc in an atmosphere of inert gas such as argon. The inert gas, introduced around the electrode wire, excludes all other atmospheric gases from the immediate area surrounding the electric arc and weld puddle. This prevents contamination of the weld by these other gases.

In welding, the arc is maintained between the tip or end of the wire and the upper surface of the plate; in cutting, however, the arc is maintained between the leading edge of the wire and the leading edge of the cut extending thoughout the full depth of the cut.

Considerable savings in time, labor and operating costs can be effected with this new process, and with no additional capital investment in equipment.

For additional information, write the Editor, POWER ENGINEERING, 110 S. Dearborn Street, Chicago 3, Ill., or write Gas Welding on postcard elsewhere in this issue.

Cutting ½-in. aluminum plate with a manual gun

Close-up view of kerf as flame cuts through plate

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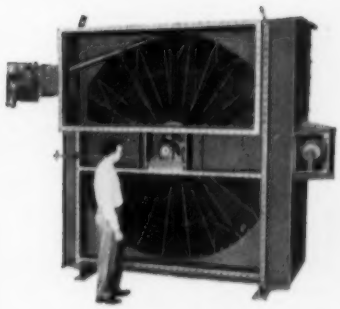

HOW MANY STACK BTUs DO YOU BUY EACH YEAR?

Whether you burn it — or dissipate it up the stack — every BTU costs you money. In fact:

Yearly cost of fuel often equals the cost of your boiler. That's why heat recovery — or dollar recovery — is so important. Boilers simply have huge appetites for fuel . . . fuel that's constantly going up and up in cost.

And small boilers are no exception. Even with relatively small boilers — that is, between 25,000 and 250,000 lbs per hr — substantial heat recovery is possible. With a Package Ljungstrom Air Preheater, fuel consumption is most often reduced 10% or more! As a result, many plants have written off their Ljungstrom within two years.

Get more steam, and cleaner stack gases. Put it another way. The BTUs that you save with a Package Ljungstrom can be used to increase boiler output. What's more, higher combustion temperatures cut slagging . . . keep stack gases clean . . . allow use of cheaper fuels . . . reduce corrosion.

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The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

For more data circle 554 on Post Card

More Ideas From F. E. Riley

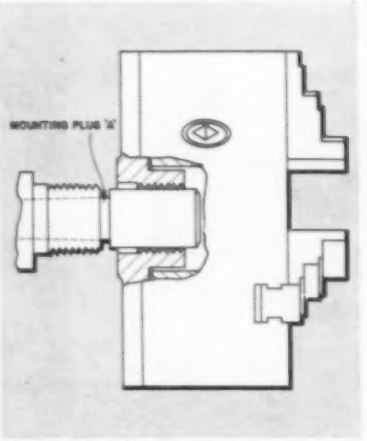
Simple Chuck Mounter

MOUNTING of chucks on the spindles of small lathes is often an awkward task to perform and it can result in damage to the threaded hole in the chuck backplate and damage to the lathe bed if the chuck should slip out of the hands. Accidents to fingers can also result.

A useful mounting tool comprises a mounting plug, as shown at A in the illustration. One end of the plug has a Morse taper turned on it for engagement with the taper hole in the spindle. The other end of the plug, which protrudes from the spindle, is turned parallel and has an outside diameter which will slide easily through the core diameter of the chuck backplate thread.

When it is desired to mount the chuck, the plug is fitted into the lathe spindle nose and the chuck is slid on to the parallel portion where it is supported and on which it can be revolved for engaging the threads. To remove the chuck the plug is fitted into the spindle taper through center hole of the chuck body and removal is a simple operation.

The awkwardness of trying to support the weight of the chuck while revolving is avoided with this device, which both supports the chuck weight and guides the threads into engagement. To prevent thread damage, the plug is made from aluminum, or some other metal softer than the cast iron back plate.

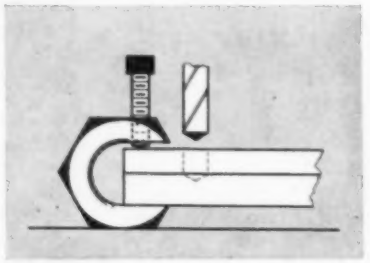


Mounting plug (A) fits into spindle, guides chuck

Large Nuts Make Handy C-Clamps

VERY USEFUL C-clamps can be made up from large steel hex nuts and suitably sized cap screws. As shown in the illustration, such clamps are particularly handy for clamping together steel plates in which it is desired to drill mating holes, or for spotting tap drill holes from a plate already drilled with clearance holes.

If a number of these clamps are made, it is best to ensure that the lower jaw face of each clamp is exactly the same measurement from the lower hex flat on which it stands. In this way, several clamps can be used in sets without danger of the work rocking on the table.


Useful C-clamps can be made from large hex nuts

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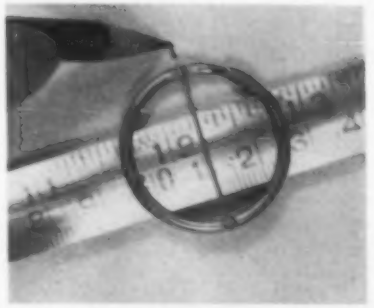
Marker for Steel Tapes

WHEN laying off duplicate measurements, the exact graduation mark on the steel tape must usually be found before the work can be marked. Possible errors are avoided and much time is saved if the tape is fitted with a sliding marker which will indicate clearly the correct measurement from the end.

The marker illustrated is made from an ordinary split key-ring. The rule or tape is inserted in the split of the ring, which can then be slid easily along the tape, but which will stay put with sufficient friction to hold it in the desired position. An additional refinement in the interests of greater accuracy is the cross wire soldered to the ring. This forms an indicator for the pencil or other mark on the work and can be positioned over the exact rule graduation required.


Key ring with sighting wire makes a handy gadget

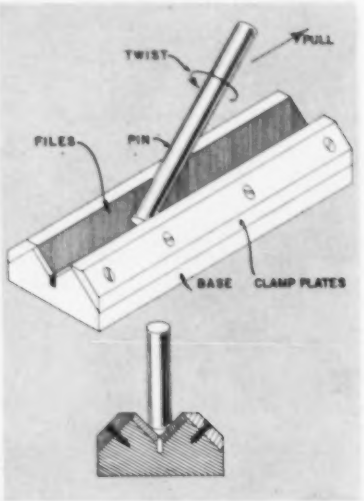
Deburring Tool—Fast, Effective

WHEN ASSEMBLING small mechanisms at the bench after repair and overhaul it will be found that burrs and bruises have been thrown up on the ends of pins and screws, making them difficult to start into holes. With the tool described, a single movement will chamfer slightly the end of a pin or screw and facilitate its assembly by providing a narrow chamfer around the edge.

The tool comprises a steel or wood base in the form of a V-block and the inside faces of the V's are formed from a pair of narrow, flat files with fine pitched teeth. The files are clamped in position on the V-block by means of external clamp plates secured in place by flat-head screws.

In use, the tool lies on the assembly bench with one end towards the user. To deburr and chamfer the end of a pin or screw, one end is inserted between the files, pulled along their length, and at the same time, twirled between the finger tips. The result of one stroke is a chamfer about 0.003 in. wide around the pin end.

The actual operation takes about 2 seconds to perform and it will be noted that no tools have to be picked up. Where several pins are to be chamfered, they can be gripped in the chuck of a drill press and revolved slowly while the tool is traversed along the projecting end by hand to produce a wide chamfer.



Make this chamfering and deburring tool with a pair of flat files clamped in a V-grooved base

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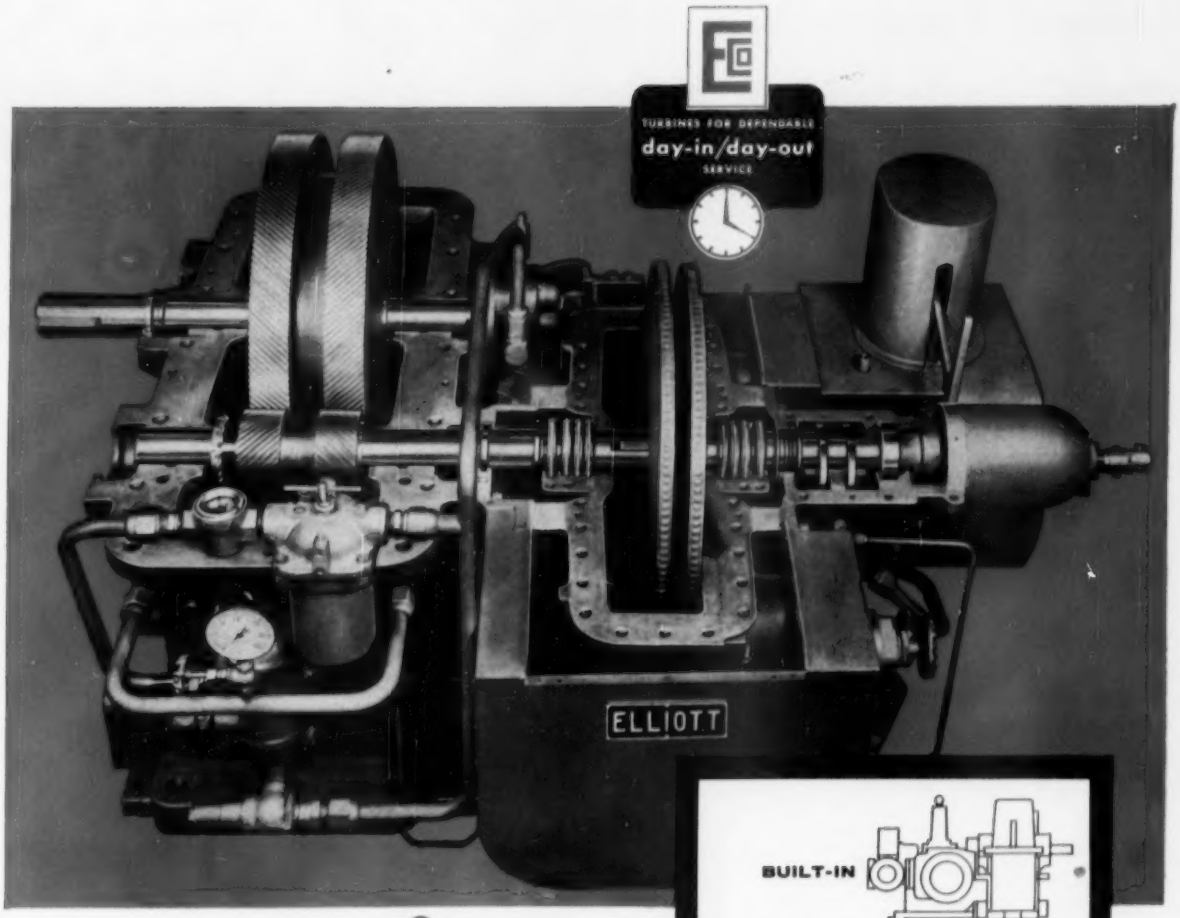
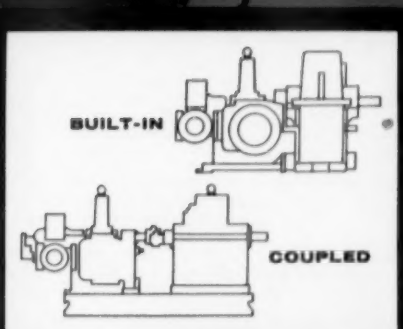


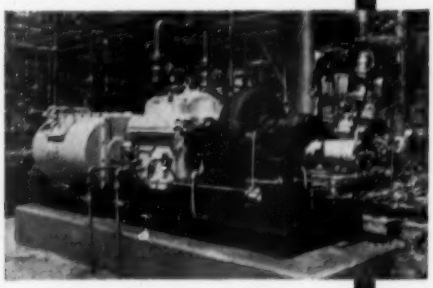
ELLIOTT *Geared* TURBINES

extend Elliott Turbine efficiency to broader range of applications

In operating many low-speed machines—such as fans, pumps, compressors and lineshafts—maximum overall efficiency is achieved by employing high-speed steam turbines which drive the machines through reduction gearing. Elliott has long been a leader in the design and application of geared turbines, built-in or coupled, which drive lower-speed machines without sacrificing the compact size or high operating efficiency of the turbine.

Design features of the built-in type, seen in the cutaway above, include: compact, rugged turbine and gear case, one-piece high-speed shaft, double-helical gear and pinion, dynamically balanced gears, liner-type bearings. These and other advantages assure sustained operating efficiency over the years. For details, ask your local Elliott field engineer for Bulletin H-19, or write Elliott Company, Steam Turbine Department, Jeannette, Pa.





Here a compressor in a petro-chemical plant is driven through separate Elliott reduction gearing by a YR turbine. In this type, the gears are coupled to the turbine by flexible couplings.

H7-3

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Lubricant Additives With a Purpose

By E. F. KOENIG *

WHAT ARE ADDITIVES? For purpose of discussion, the term additives may be defined as chemical compounds which will either enhance or improve some of the properties which a petroleum product already has, or impart new characteristics to it.

For ease of discussion, lubricant additives may be divided into:

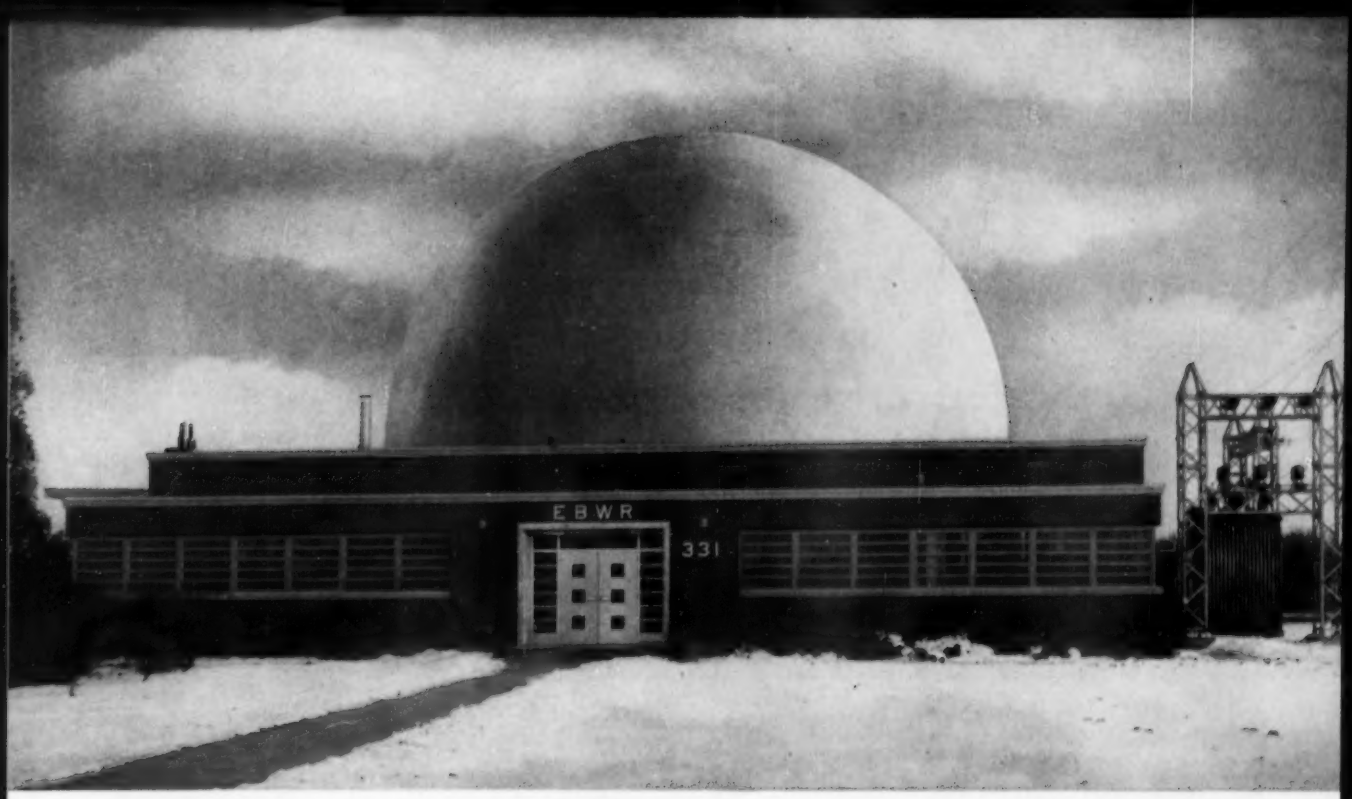
A. Those that affect some physical characteristic of the lubricant such as viscosity index, pour point, foaming, etc.;

B. Those whose end effect is more chemical in nature and usually more measurable in terms of some performance characteristic. This includes materials such as oxidation-corrosion inhibitors, detergents and dispersants, extreme pressure, anti-wear, and oiliness.

There are many hundreds of chemical compounds that have been found to impart or enhance some individual property of a lubricant. However, the fact that these compounds must be compatible with other chemical addition agents as well as the base lubricant greatly reduces the number of usable ones. Accompanying table, from *Lubrication*, March 1957, briefly summarizes pertinent information on the commonly-used lubricant additives.

* Research and Technical Department The Texas Co., Beacon, N. Y.

Type Additive	Type of Compounds Used	Reasons for Use	Mechanism of Action
Anti-oxidants or Oxidation Inhibitors	Organic compounds containing sulfur, phosphorus or nitrogen such as organic amines, sulfides, hydroxy sulfides, phenols. Metals like tin, zinc or barium often incorporated.	To prevent varnish and sludge formation on metal parts. To prevent corrosion of alloy bearings.	Decreases amount of oxygen taken up by the oil thereby reducing formation of acidic bodies. Terminates oil oxidation reactions by formation of inactive soluble compounds or by taking up oxygen. Additive may be oxidized in preference to oil.
Anti-corrosives Corrosion Preventives or Catalyst "Poisons"	Organic compounds containing active sulfur, phosphorus or nitrogen such as organic sulfides, phosphites, metal salts of thiophosphoric acid, and sulfurized waxes.	To prevent failure of alloy bearings by corrosive action. To prevent corrosive attack on other metal surfaces.	Inhibits oxidation so that no acidic bodies are formed or enables a protective film to form on bearings or other metal surfaces. Chemical film formation on metal surfaces decreases catalytic oxidation of the oil.
Detergents	Metallo-organic compounds such as phosphates, phenolates, sulfonates, alcoholates. High molecular weight soaps containing metals like magnesium, barium, calcium, tin.	To keep metal surfaces clean and prevent deposit formation of all types.	By chemical reaction or oxidation direction, oil soluble oxidation products are prevented from becoming insoluble and depositing on various engine parts.
Dispersants	Metallo-organic compounds such as naphthenates and sulfonates. Organic salts containing metals, like calcium, cobalt and strontium.	To keep potential sludge forming insolubles in suspension to prevent their depositing on metal parts.	Agglomeration and deposition of fuel soot and insoluble oil decomposition products is prevented by breakdown into finely divided state. In colloidal form contaminating particles remain suspended in oil.
Oiliness, Film Strength, Extreme Pressure (E.P.) and Anti-Wear Agents	Organic compounds containing chlorine, phosphorus and sulfur such as chlorinated waxes, organic phosphates and phosphites such as tricresyl phosphate and zinc dithiophosphate, and lead soaps such as lead naphthenate.	To reduce friction, prevent galling, scoring and seizure. To reduce wear.	By chemical reaction film is formed on metal contacting surfaces which has lower shear strength than base metal thereby reducing friction and preventing welding and seizure of contacting surfaces when oil film is ruptured.
Rust Preventives	Sulfonates, amines, fatty oils and certain fatty acids, oxidized wax acids, phosphates, halogenated derivatives of certain fatty acids.	To prevent rust of metal parts during shutdown periods, storage or shipment of new or overhauled equipment.	Preferential adsorption of polar type surface active materials on metal surface. This film repels attack of water. Neutralizing corrosive acids.
Metal Deactivators	Complex organic nitrogen and sulfur containing compounds such as certain complex amines and sulfides. Some soaps.	Passify, prevent or counteract catalytic effect of metals on oxidation.	Form inactive protective film by physical or chemical adsorption or absorption. Form catalytically inactive complex with soluble or insoluble metal ions.
Stringiness and Tackiness Agents	Certain high molecular weight polymers and aluminum soaps of unsaturated fatty acids.	Increases adhesiveness of lubricant on metal surfaces, form protective coating.	Increases viscosity of lubricant and imparts adhesive and tackiness characteristics.
Water Repellents	Organosilicon and other polymers, certain higher aliphatic amines and hydroxy fatty acids.	Provide water repellent or resistant properties to non-soap thickened greases and other lubricants.	Surface active agents form protective film on grease thickeners or other components of lubricants to reduce their affinity for water.
Emulsifiers	Certain soaps of fats and fatty acids, sulfonic acids or napthenic acids.	Used to emulsify soluble oils with water to give coolant lubricant type fluid.	Surface active chemical agents reduce interfacial tensions so oil can be finally dispersed in water.
Dyes	Oil soluble organic compounds with high coloring power.	Provide distinctive or attractive color.	The organic compounds with high coloring power (dyes) dissolve to impart color.
Color Stabilizers	Certain hydroquinones, dithiocarbamates, aliphatic amines, dicyclohexylamines.	Stabilize color and prevent formation of undesirable color.	Certain chemicals can destroy color forming bodies by stopping or changing chemical reaction forming them. Sometimes accomplished by oxidation inhibitors functioning as indicated above.
Odor Control Agents	Certain oil soluble synthetic perfumes, sometimes nitro benzol.	Used to provide distinctive or pleasant odor or mask undesirable odors.	Small amounts of highly odoriferous substances impart fragrant or pleasant odor when mixed with lubricants.
Antiseptics (Bactericide or Disinfectant)	Certain alcohols, aldehydes, phenols, mecuric compounds and chlorine containing compounds.	Used to control odor, foaming, metal staining, emulsion breaking in emulsion type lubricants.	Used in soluble oils to reduce or prevent growth of bacteria causing deleterious effects in emulsion lubricants.
Pour Point	Wax alkylated naphthalene or phenol and their polymers. Methacrylate polymers.	To lower pour point of lubricating oils.	Wax crystals in oils coated to prevent growth and oil absorption at reduced temperatures.
Viscosity Index	Polymerized olefins or iso-olefins. Butylene polymers, methacrylic acid ester polymers, alkylated styrene polymers.	To lower rate of change of viscosity with temperature.	Improvers are less affected by temperature change than oil. They raise viscosity at 200°F. more in proportion than at 100°F. due to their change in solubilities.
Foam Inhibitors	Silicone polymers.	To prevent formation of stable foam.	Reduces interfacial tension so small air bubblets can combine to form larger bubbles that separate faster.



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from Dedication address, Feb. 9, 1957, by Rep. Carl T. Durham, Chairman, Joint Congressional Committee on Atomic Energy.

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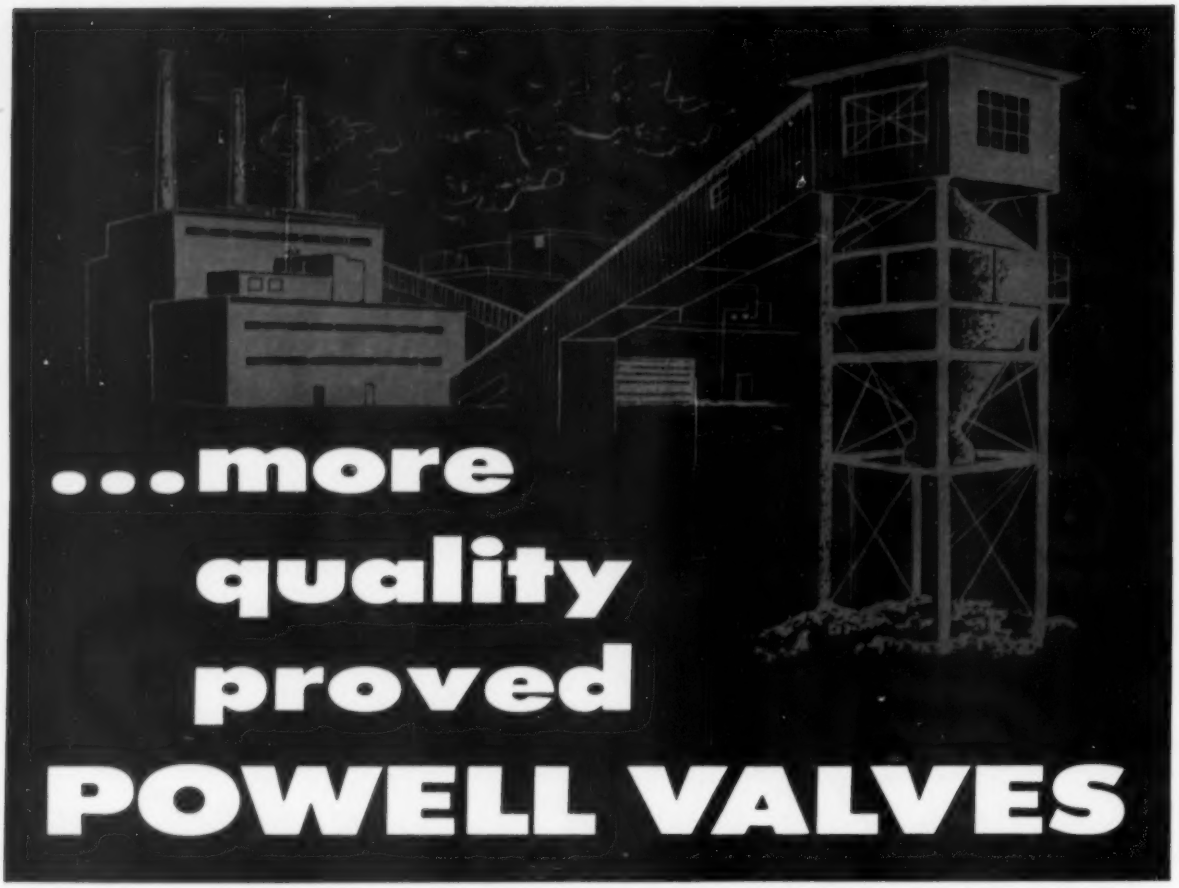

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FIG. 9003 W.E.—900-Pound Steel Gate Valve, Bolted Flanged Yoke, Outside Screw, Rising Stem.

FIG. 375—Bronze Gate Valve for 200 Pounds W.S.P. Inside Screw Rising Stem.

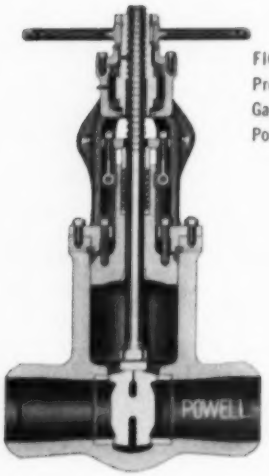

FIG. 11303 (Sec.)—Pressure Seal Steel Gate Valve, 1500 Pounds. Welded Ends.

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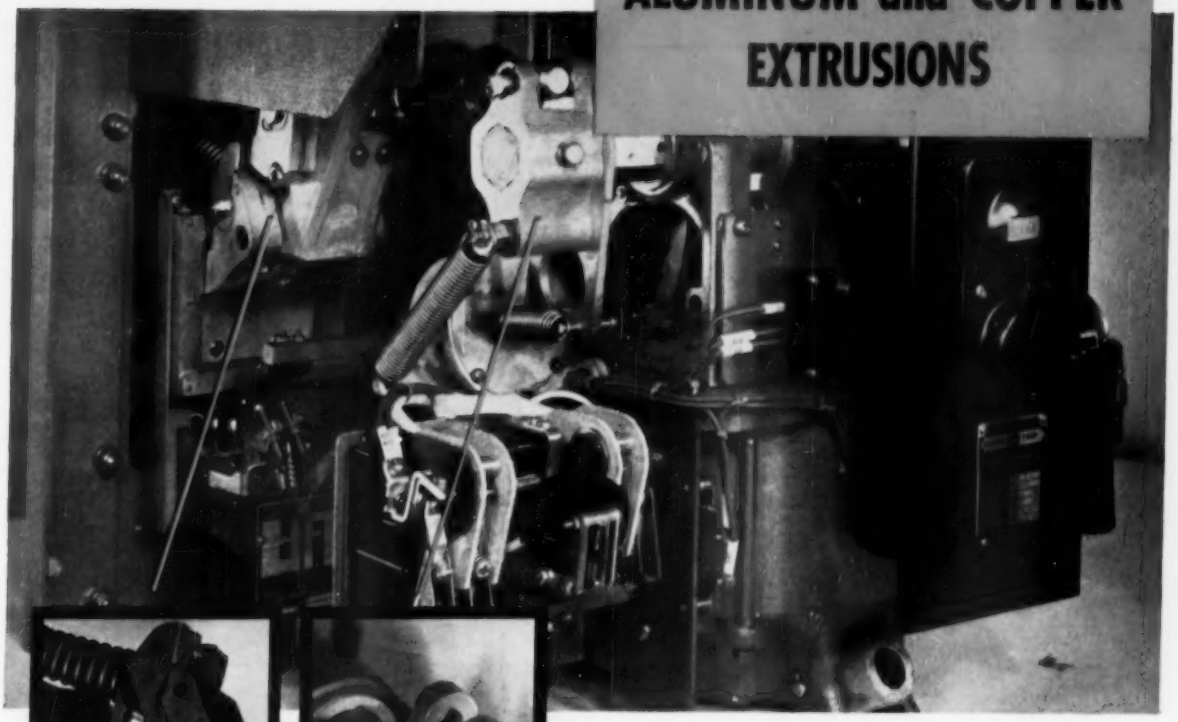
REVERE
ALUMINUM and COPPER EXTRUSIONS

I-T-E CIRCUIT BREAKER—KD (3,000 amp. rating) showing progressive assembly with Revere Copper and Aluminum Extrusions in place. I-T-E Circuit Breaker—KE is same type with 4,000 amp. rating.



COPPER
for conductivity

ALUMINUM
for economy

—form a Money-Saving team in latest I-T-E CIRCUIT BREAKERS

Revere T. A. Service an Important Factor in Ultimate Design of Parts

The larger of the two extruded and drawn copper shapes shown at extreme left started out on the drawing board as two pieces. It was thought that a single shape of this size could not be made satisfactorily. At this point, I-T-E Engineers got together with Revere's T. A. (Technical Advisory) Service and threshed things over. The final result is the one-piece extrusion shown and a reduction in machining time.

Aluminum was selected for the other extrusion shown because I-T-E found that it cost less per pound of metal and had a higher strength ratio when compared to a casting. Also, space was a factor. In all, Revere supplies 5 copper and 2 aluminum extrusions for KD and KE type I-T-E Circuit Breakers. All were designed to fit specific requirements of I-T-E Engineers. Where it could be used satisfactorily, aluminum was applied because of economy, while current carrying members called for copper.

This is still another example of Revere supplying the metal that will do the best job and with the greatest economy . . . be it aluminum, copper or any one of their alloys. So, with new things happening all the time in non-ferrous metals it can pay you to keep in close touch with Revere.

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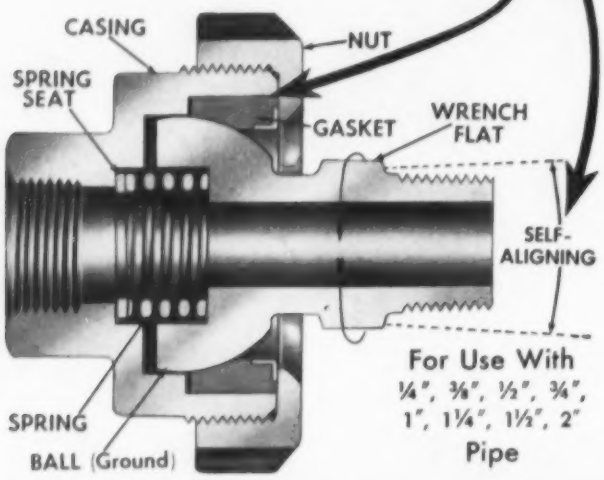
1. Self-Aligning Ball
2. Chemically Inert Seal



BARCO SWIVEL JOINTS

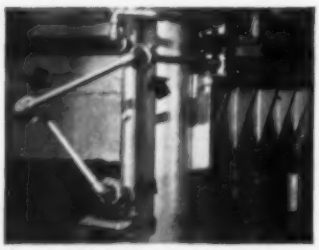
for STEAM, OIL or WATER LINES

Two important features give Barco Swivel Joints capabilities not found in ordinary swivel joints:

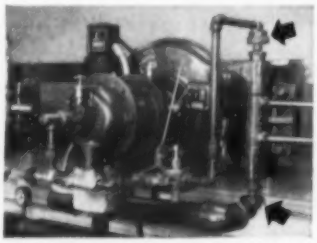
SELF-ALIGNING—Provides a wide tolerance for pipe fitting and machine alignment. Saves endless hours installation time and permanently protects against binding and wear.

CHEMICALLY INERT SEAL—Pressure sealing and automatically self-adjusting for wear. Ideal for steam service. Uniform performance over temperature range from −50° to +600°F. No lubrication needed.

Send for Catalog 265B, "Barco Self-Aligning Swivel Joints." Ratings as high as 750 psi steam or 3000 psi hydraulic. Sizes ¼" to 2"; angle or straight. *Ask for recommendations—Barco is at your service.*



PLATEN PRESS—Barco Swivel Joints (see arrows) in "dog leg" piping provide flexible connection to moving platen of press. Platen moves up and down. Line handles steam and cold water alternately.



OIL BURNER—Two Barco Swivel Joints (see arrows) mounted as pivot points on hinge provide swivel connections for fuel oil and steam atomizing lines to door mounted oil burner.

FOUNDED 1918 BARCO PRODUCTS BACKED BY EXPERIENCE

BARCO MANUFACTURING CO.
547E Hough Street • Barrington, Illinois

The Only Truly Complete Line of Flexible Ball, Swivel, Swing and Revolving Joints
In Canada: The Holden Co., Ltd., Montreal

For more data circle 559 on Post Card

Build New Plant Right!

continued from page 93

pump installed under the drip from a leaky tank or the switch box put in the way of escaping steam from a pop valve or leaky pipe joint?

Use Care with Accessories

Items such as water columns should be carefully installed. Where pipes are short and inflexible, final alignment should include heating and slightly bending the piping for exact fit. The water columns on a boiler drum are a good example of a difficult fitting job, since their pipes are usually short, and alignment must be exact to prevent strains when making up the last joint.

Photoelectric smoke indicator lights should be carefully mounted so that adjustment is possible in all directions for later possible corrections. I have seen some unbelievably amateur jobs in mounting these units, using techniques of "bolt bending," "plate shimming," and "washer equalization" to compensate for a poor initial alignment. I have seen precision pre-focused projector lamps held in place on a piece of plywood by wood screws in lieu of a proper socket assembly.

Another good practice is to use your good sense in case something "just doesn't look right." Don't be put off by being told that "It's common practice," or "We've never had any complaints before," or "We've always done it this way." Judge for yourself, from your reading of available instructions and use of logic, whether a job is properly done. For instance, steam leaks which are persistent may indicate improper installation or defective material. In a few months' old plant, I have been confronted with the following conditions:

1. Pinhole in cover plate of a high-pressure trap;
2. Pinhole in bonnet of a 14-inch main high-pressure stop;
3. Use of cheap cast iron in place of semi-steel in water column castings.

Although the manufacturer replaced the defective piece in each case, the inconvenience and installation cost were ours. In the last instance, the manufacturer was quite surprised to learn that his castings were not up to snuff. It seems that the foundry used a defective lot of casting steel, and apparently all the sub-standard units had not been recalled!

Get Boilers Installed Right

Now, a short discussion of boiler installation may be in order. It is well to ascertain if the boiler manufacturer just sells the steel, and from there on it's up to you, or whether the manufacturer will follow up the erection and installation of his equipment. Both types of service are available. Obviously, the cheaper service

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Your Mogul Service Man will survey all equipment requiring treatment. Our Service Department will review this survey and make treatment recommendations.

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Our Service Department is available for water problem consultation at all times. Water samples will be analyzed and results reported to you at No Charge.

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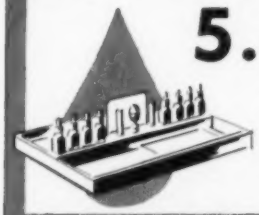
4. REPORT CHARTS

Mogul Report Charts are supplied so you may keep daily records of your water control tests. Monthly charts may be submitted for Service Department review and comments.



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We furnish you with a Mogul Test Set. TEST SET REAGENTS ARE SUPPLIED AT NO CHARGE.

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Your Mogul Service Man will assist your operating personnel in the use of Mogul products, and proper feeder requirements.

When you MOGUL-IZE your operating equipment with Mogul Quality Products and Mogul Service you are assured of receiving protection from the damaging effects of water.

MOGUL offers a completely integrated water treatment program with performance results "guaranteed and backed by a bond".

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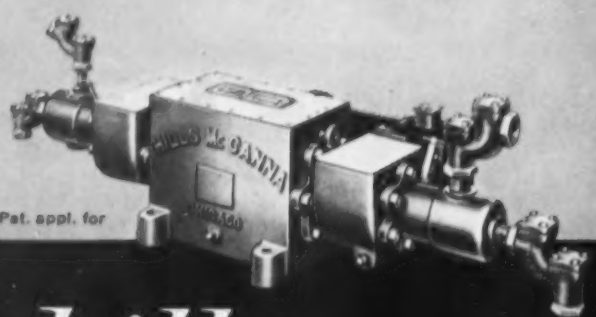

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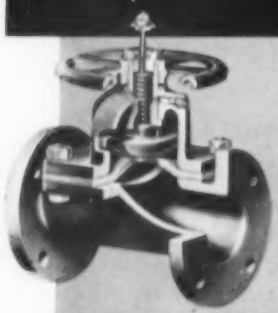

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Build New Plant Right!

continued from page 116

will require increased vigilance on your part to see that you get the best possible installation. Because the boilers are often the most expensive single component of a plant, careful attention should be paid to their preparation for service.

Probably the most frequent cause of annoyance with a new boiler lies in the refractory. Be sure that your insulating bricks are not laid by an ordinary bricklayer but by a qualified refractory mason. Laying up of firebrick is an art only remotely related to the erection of structural brick. The material should be adequate for the service involved. It is good economy to get a grade of fire brick one step better than you think you need, since burned brick is expensive to replace. Expansion room is mandatory — see that $\frac{1}{4}$-in. is allowed for every four feet of brick wall. This can be assured by the insertion of a $\frac{1}{4}$-in. thick strip of plywood every 4 ft. The plywood will burn out when the boiler is fired.

Firebricks are ground square, and in this work, mortar is used not as a filler, but only as an adhesive. Joints should be as thin as possible, as in Fig. 7. Anything over 1/16 in. is too much separation between bricks.

The secondary or back-up insulation should not be exposed anywhere, so watch especially around openings, such as door frames, for this condition. There is now on the market a light insulating brick that is used for both primary and secondary insulation, but these are used only for special purpose installations. The usual back-up insulation must be protected.

Burner fronts should be high temperature, high quality, plastic or preformed molded ceramic. The ceramic should be anchored to the steel fronts by special alloy anchors,

"Yes, we've tried your new wonder pipe covering — and found it wanting . . ."

New boiler at Mando burns coal the modern way for economical steam generation

Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

Mando—the Minnesota and Ontario Paper Co.—is keeping pace with continuing production expansion. The firm recently installed in its plant at International Falls, Minn., one of the largest modern single-pass boilers in the pulp and paper industry. It is designed to produce 240,000 lbs. of steam an hour, bringing the mill's steam generating capacity to 960,000 lbs./hr. The new boiler has 22,500 sq. ft. of heating surface and required 300,000 lbs. of steel in its construction. It will use 775,000 gallons of water a day and, for economy, will burn pulverized coal as a primary fuel—300 tons daily!

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

BITUMINOUS COAL INSTITUTE
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for Practical Electrical Men Tells How to Use the Popular

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What makes good insulation go bad?
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What testing procedures should be practiced?
How to interpret meter readings?
Does periodic testing pay off?

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Write for BULLETIN 21-PE.

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Build New Plant Right!

continued from page 118

which should extend to within 2 in. of the surface. The proper type of anchor will not only hold the burner cone in place but will serve as internal reinforcement to prevent cracking. The burner cone must be truly concentric with the spray nozzle.

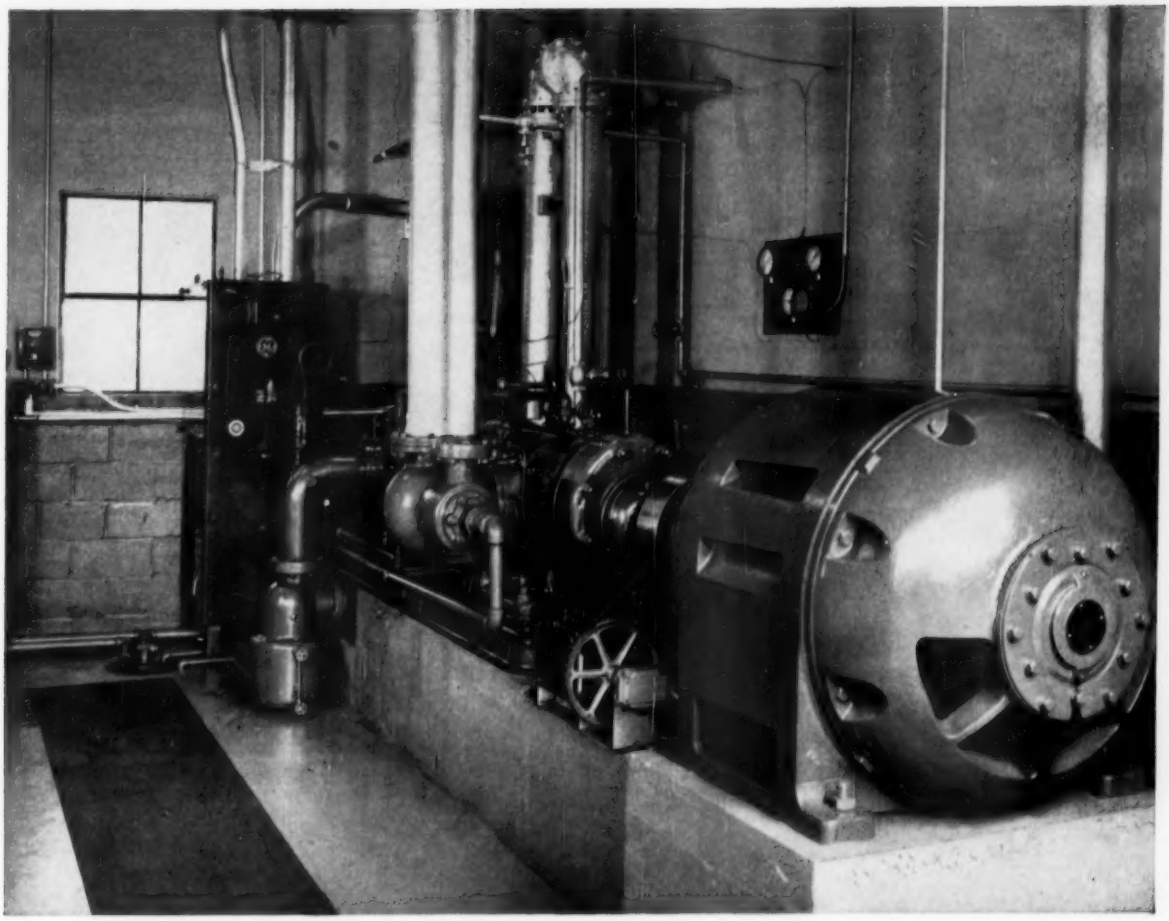
Two types of plastic refractory material are available; one requires that it be kept moist until firing; the other type is a hydraulic-setting mortar usually referred to as air set. The second type acquires strength by reaction with the water. Make sure which type is being used in your installation so that you can be sure that the proper moisture condition is maintained or that it is properly dried out. When placing this material, it should be firmly rammed or pounded. The material may be received as a powder, which should be freshly mixed just before use, or as a prepared plastic, which should be used "as is," immediately upon opening the container. Re-worked dried plastic should not be used, except for small patch jobs. Holes should be punched all over the surface on 1½-in. centers, using a ¼ or 3/16-in. welding rod. The surface should be stippled with a brush or hacksaw blade.

Look at your boiler carefully after a few firings. If you see nice, clean cracks, these are expansion cracks and will close up when firing. A dirty or sooted crack should be repaired. Also, watch for a nice, shiny, glazed brick surface. This indicates that the brick is melting or overheating. And, finally, make a check to see that as few edges or corners as possilbe are showing, for these regions will burn out first.

Tubes and Casings

When rolling tubes, be sure that the tubes are not over-rolled. Your best guarantee of this is a boilermaker who knows his business. You can tell by watching him work. As a rule, no

"Now here's my idea for slowing down the rush at quitting time."



Fuller Rotary Two-Stage Compressor, C135-135H. Capacity 680 c.f.m., 100-lb. pressure, 690 r.p.m., 150 hp. motor.

16,000 HOURS OF OPERATION WITH NO MAINTENANCE

Empire Steel Castings, Inc., Reading, Pennsylvania, installed a C-135-135H Fuller Rotary Two-stage Compressor in April 1953. After 32 months—approximately 16,000 hours of operation—the compressor received a routine inspection, when a new set of blades was installed in the higher-pressure cylinder.

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- In the core department, for ramming equipment, spraying and torch drying equipment, core oven operation as well as core blowing equipment.
- In the cleaning department, pneumatic chipping hammers and grinders, blacksmith requirements, sand-blasting, pressure testing and miscellaneous tools.
- In the heat-treating department, heat treating furnace operation and cooling equipment.

To get all the facts and engineering data, write today for Bulletin C-5A.

C-298
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● Don't be misled into thinking that one type of steam trap meets all requirements. Each type of trap has a purpose—operates efficiently only under certain conditions. The correct selection of the right type of trap for each application pays for itself by draining *all* condensate and venting *all* air in the *shortest* possible time.

ANDERSON STEAM TRAP SELECTION GUIDE

Super-Silvertop INVERTED BUCKET

For normal inside uses. More efficient since condensate, rather than temperature differentials, actuates the trap. Patented guided bucket arrangement eliminates bucket damage and assures positive seating.

Heat-Kwik COMBINATION BUCKET AND THERMOSTATIC

For extremely fast heating up. Unique combination design vents air eight times faster from cold units. Permits production units like cookers, dryers, autoclaves, kettles to reach maximum capacity in 2½ minutes.

Quik-Flex THERMOSTATIC

For all outdoor applications. Wherever a freeze-proof trap is required such as tracer lines, meter boxes, etc. Particularly recommended for refineries, chemical, petrochemical and other outdoor type plants.

Anderson FLOAT Traps

For continuous trapping. Such as ahead of condensate meters (bucket traps operate intermittently). Also for draining moisture and entrainment from *air* and *gas* pipelines, purifiers, separators and other equipment.

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QUALITY STEAM TRAPS SINCE 1886

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Build New Plant Right!

continued from page 120

tube should be rolled more than twice. The final check, of course, is tightness under hydrostatic test.

It is important that air casings on boilers be leak tight. One test is to put air pressure on the casings and test with a candle along the seams and penetrations. Another test is to put a smoke bomb in a pressurized firebox, then just watch the smoke come out! In any event, these, or other simple tests, should be used to check tightness of casings. It is not enough to plug up leaks with asbestos plaster. Instead, use a resilient caulking or asbestos rope or wicking followed by asbestos plaster. When the first application is dry and hot, it will shrink, so it may be wise to go over the worst spots with a second application.

In a new boiler, it may be an economical precaution to coat the waterside before putting into service. This can be done to a new boiler cheaply and will result in increased life.

Your final check on a boiler installation should be to see that the center of the water glass is level with the required water level in the drum. Use a transit or level line to check this.

Look at the Building Itself

And as finale to this discussion, let me point out a few things about your building which are often neglected. The floors should be properly sloped for drainage. This is not merely convenient but is necessary in case of leakage, or for easy draining of tanks, and to insure safety. Be sure that all parts of your floor drains are available for cleaning out, and be sure that the builder will remove all the insulation and material that have accumulated in these pipes during construction.

Include pad-eyes above heavy equipment for lifting; install safety rails where needed. Insulation that may be walked on should be metal covered. Ladders should be built into places which must be regularly reached for operation or servicing.

And for safety's sake! Watch those head-denting, low-slung, steel beams under steps or platforms. Pad them or extend a post from the floor to the offending beam corner.

Having thus considered all the above conditions, you will have considerable assurance that your new plant will be a dream and not a nightmare!

WOULD YOU LIKE TEAR SHEETS?

Readers wanting tear sheets of any article appearing in the issue for their personal file may obtain them by indicating the item desired on one of the post cards appearing in this issue—Editors.

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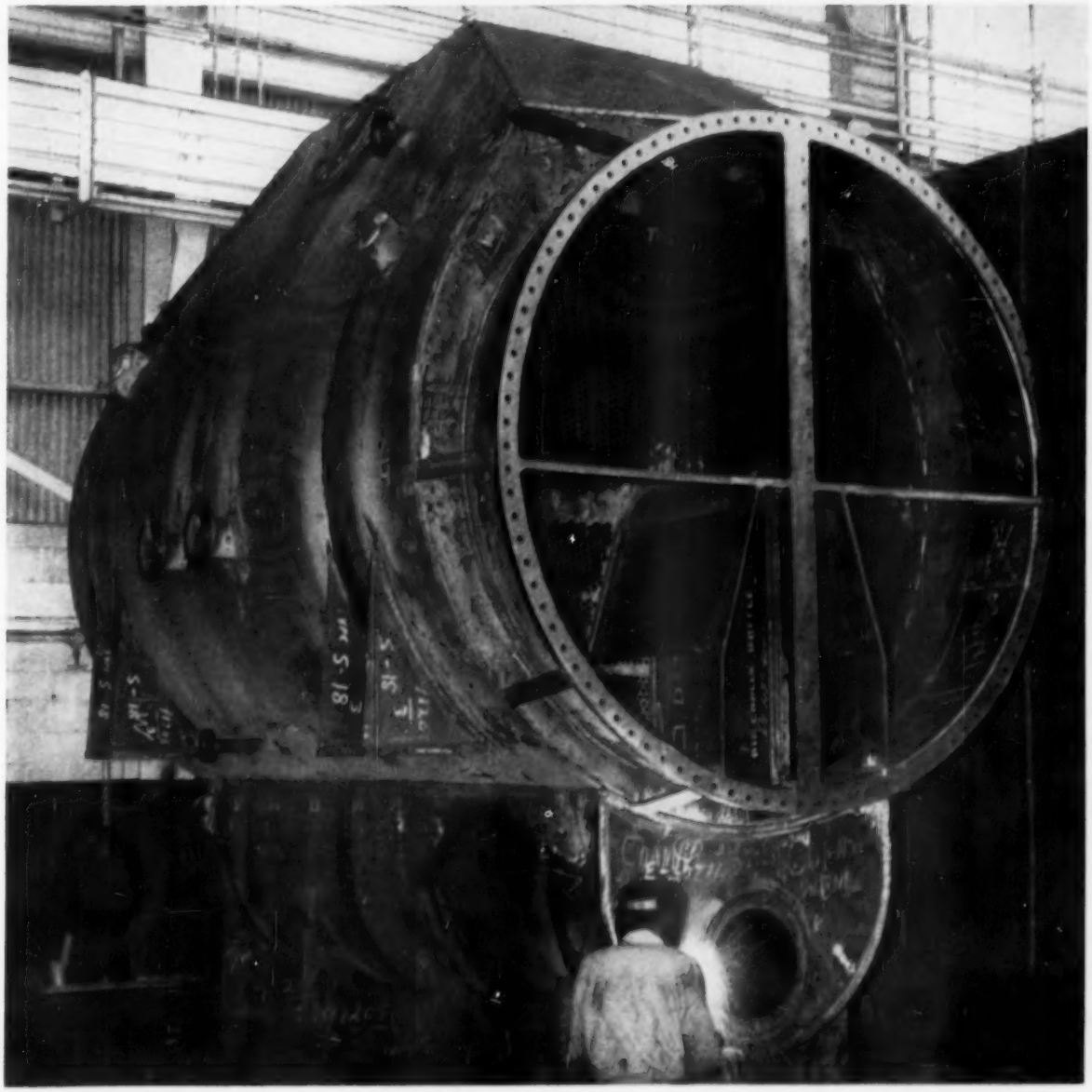

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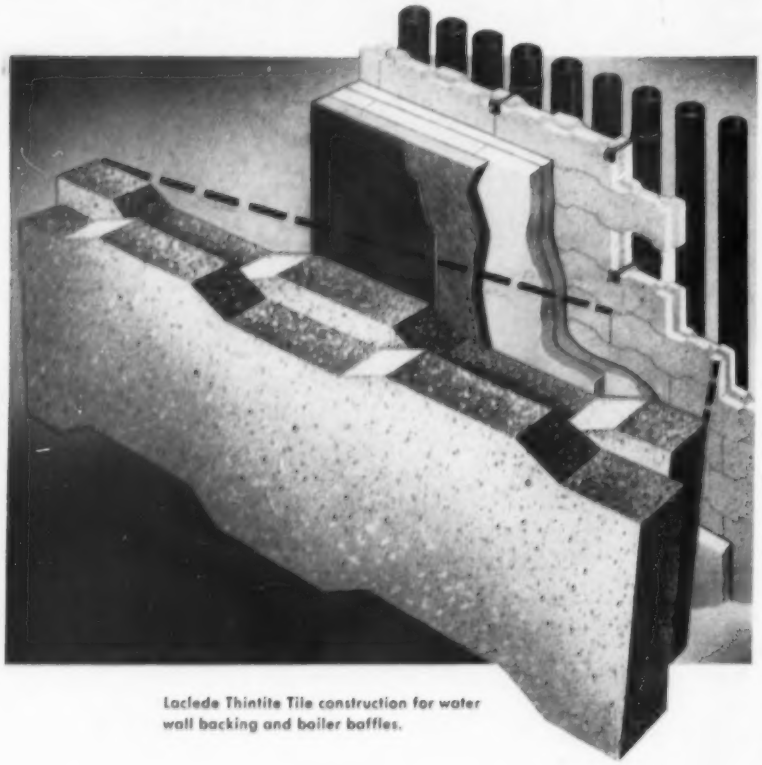
New trends in the use of refractories



Laclede Thintite Tile construction for water wall backing and boiler baffles.

Reduce costs, speed up installation with interlocking Laclede Thintite Tile

Interlocking Laclede Thintite Tile offers *exclusive* advantages for water wall backing, as well as for boiler baffles and roof coverings. Tile sections interlock quickly and easily, reducing installation time and lowering cost per square foot. This interlocking design keeps the wall tightly sealed—reduces leakage to a minimum. Also, the Thintite wall is completely uniform—free from deformation or warpage.

Light weight Thintite Tile is machine-made of first quality fire clay to a single shape. The single shape permits use of Thintite for walls, baffles and roofs, thus reducing inventory requirements.

Call your Laclede-Christy representative for all the facts. *Refractories Division, H. K. Porter Company, Inc., St. Louis 10, Missouri.*

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NEW ENGINEERING BOOKS

Correction Note: In the November 1956 issue, page 135, we should have stated that the book entitled Legal Problems in Engineering was by Melvin **Nord** and not by Melvin Ford as published. We apologize to both Dr. Nord and the publisher for this slip of the typewriter. Dr. Nord is already well known as author of other popular books, and of articles on legal aspects of engineering in various technical magazines.

* * *

Electrical Interference by A. P. Hale. First Edition, 1956. 122 pages, 7¼ by 4¾ in., cloth. Published by Philosophical Library, 15 E 40th St, New York 16, N. Y. Price $4.75.

In the year 1954 the British General Post Office was called upon to investigate some 140,000 complaints of interference with radio and television reception. When it is realized that many more complaints were settled without recourse to the Post Office, an idea may be obtained of the magnitude of the problem. The chief course of dissatisfaction was the wide range of high frequency noise, normally the result of operating electrical machinery; although approximately ten percent of the interference was caused by inefficient aerial or ground installations at the receiving site.

Present literature on this subject is scarce, being largely in the form of papers in technical journals. Specialist engineers have gained most of their knowledge from practical experience and have rarely put it into print.

This book has been written from a thoroughly practical point of view. It describes the cause of interference; the effects of interference; the receiver aerial systems; measurement of interference levels; locations of sources of interference; avoidance of interference; basis filters; safety; practical filters, and Faraday cages. A particularly valuable feature is a series of remarkable photographs of a television screen showing the effects of different types of interference on the picture.

* * *

A-C Switchgear, Vol I: A Survey of Requirements, by J. R. Morelock. First Edition, 1956. 387 pages, 8¾ by 5¼ in., cloth. Published by Chapman & Hall, 37 Essex St, London, W.C.2, England. Price 50 shillings.

The purpose of this book is to give some guidance to system engineers in the problems associated with the determination of the ratings of switchgear. It is an advanced book intended for specialists. As the authors point out, it is not intended as a design manual,

NUCLEAR NEWS FROM ATOMICS INTERNATIONAL

OMR a promising approach to meet world's need for small to large power plants

An important goal of the Atomic Energy Commission's program to develop electric power from the atom is a low-cost reactor for plants with gross outputs of 10 megawatts or more. Such plants are particularly suited to areas that need relatively small increments of additional power, and to those parts of the world where coal, oil, and water-power are scarce or costly.

The OMRE (Organic Moderated Reactor Experiment), which ATOMICS INTERNATIONAL is now building at the National Reactor Testing Station in Idaho, is one of the more promising types for this purpose. The new experimental reactor was pioneered by ATOMICS INTERNATIONAL – from preliminary design to prototype.

It will be used to investigate the rate of degradation of organic fluids, the properties and compositions of the equilibrium mixture in the reactor, and the effect of organic fluids on heat-transfer surfaces. Results of these experiments will be incorporated into the nuclear power plants ATOMICS INTERNATIONAL is planning for Piqua, Ohio and a Latin American country.

Basic advantages of the OMR are small size, compact core with good neutron economy, and elimination of problems with high-pressure primary coolant circuits and uranium-coolant reaction hazards. Its safety features are outstanding. The high boiling point of the organic moderator-coolant fluid permits a low-pressure system. There are no chemical incompatibilities between coolant and uranium or coolant and water, and no unusual corrosion problems. Because of its fluid moderator—an isomeric terphenyl—the OMR has a negative temperature coefficient of reactivity, which acts as a governor in case of power surges or excess power levels. The organic fluid becomes only slightly radioactive, which makes the entire heat-transfer system relatively accessible.

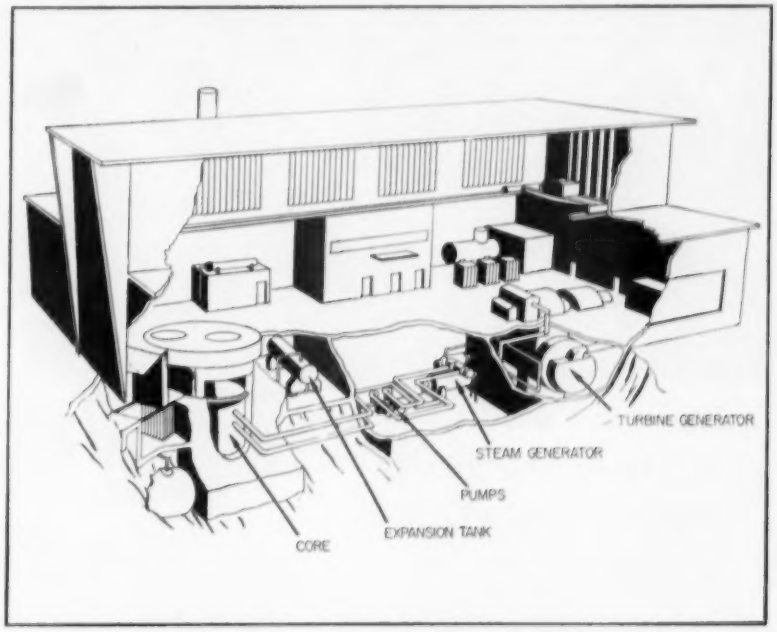
A typical power plant, such as the one proposed for Piqua, Ohio, has a gross electric output of 12,500 kilowatts and a heat output of 45,500 thermal kilowatts. It produces steam at a pressure of 415 psig (29 kg/cm^2) and a temperature of 550°F (288°C).

The reactor core is heterogeneous, with fuel elements and control rods immersed in the moderator-coolant fluid and contained in a thin-walled core tank. The fuel is uranium slightly enriched in U^{235}.

Power costs for this reactor, including both capital and operating charges, are estimated at 18 mills per kilowatt-hour. Power costs will be significantly lower in larger OMR plants. Lower power costs are also expected to result from advances in OMR technology.

Atomic power for supertankers. The AEC has assigned ATOMICS INTERNATIONAL the challenging design study to adapt the OMR for maritime use. The OMR, considered a promising possibility for ship propulsion, is expected to be particularly suitable for supertankers. The OMR offers the safety of a low-pressure system, low construction costs (because it can be built of aluminum and mild steel instead of more expensive zirconium and stainless steel), and low maintenance costs.

ATOMICS INTERNATIONAL is staffed and equipped to help you with any phase of reactor development. Please write: Director of Technical Sales, Dept. PE-72, ATOMICS INTERNATIONAL, P. O. Box 309, Canoga Park, California. Cable address: ATOMICS.



Typical OMR Central Station Nuclear Power Plant

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.
PIONEERS IN THE CREATIVE USE OF THE ATOM

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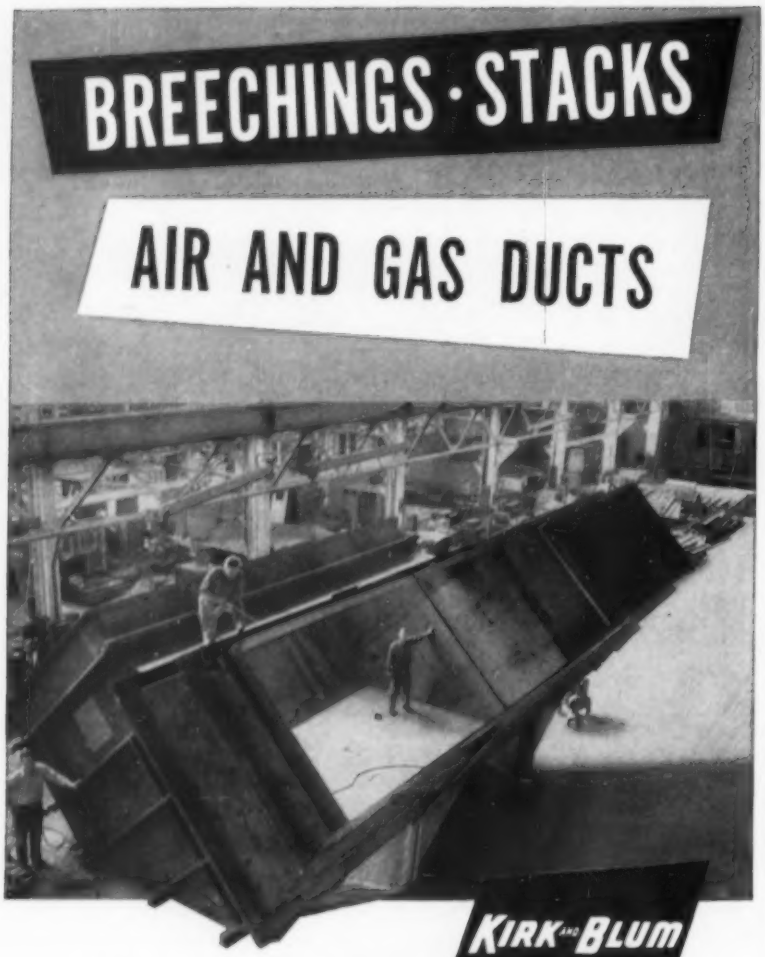

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For detailed literature, write: The Kirk & Blum Mfg. Co. 3230 Forrer St., Cincinnati 9, Ohio

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Engineering Books

continued from page 124

since the choice of protection, re-striking transient determination, and insulation levels, items covered in this book, are very much the province of experts.

To segregate a faulty circuit, it is essential that its location be determined and consequently the basic principles of operation of different types of protection and relays are considered. To insure correct operation of the protective gear, the measurement of fault currents and voltages is essential, and the performance under these conditions of normal devices for doing this is treated.

The remainder of the book is concerned with the voltage aspects of the problem. Some consideration is given to the phenomena associated with the initiation of arcs, and this leads to the concept of re-striking voltage. Some guidance for determining re-striking voltages is given for simpler cases.

The last paragraph of the book discusses the question of insulation level, which at the higher voltages governs, to a large extent, the cost of installation.

The author plans a second volume to deal more specifically with the details of switchgear arrangements and basic design principles.

* * *

The Insulation Level of Power Transformers. First Edition, 1956. 21 pages, 10¾ by 8½ in., paper. Prepared and published by The British Electrical and Allied Manufacturers' Association, 36 Kingsway, London WC2, England. Price 5 shillings.

The development of electric power transmission by overhead lines and the introduction of increasingly higher transmission voltages necessitates special attention being paid to the insulation levels required for such transmission lines and equipment.

The primary factor in assessing the insulation levels required is the voltage surge caused principally by lightning. Such surge phenomena and the development of techniques for impulse-voltage tests has been the subject of much study and debate.

After much study the British Electrical and Allied Manufacturers Association presented its conclusions and recommendations to the British Standards Institution. Part of these proposals will be included in a new section of the National Standard on electrical performance of transformers for power and lighting. The new section will deal with insulation levels and impulse-voltage tests.

A major revision of a national standard, however, requires consultation and discussion with all interests and thus considerable time must elapse before a revised addition of such a comprehensive standard can be completed and published.

It has been suggested that in this interim period, while consultation and discussion are taking place, that some guidance be made available in convenient form of the British

Unretouched photo showing typical return line corrosive action resulting from carbonic acid and dissolved oxygen in condensate.

BREAKING DOWN WITHIN

This section of pipe looks like new—on the outside. But take a look inside. Grooving action caused by carbonic acid and deep pitting, the result of dissolved oxygen attack, have almost completely penetrated the pipe wall.

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Power engineers in leading industrial and commercial plants place their confidence in Dearborn's 70 years of experience in water chemistry. They have found the answer to the demand for complete plant protection in Dearborn Supervisory Service—a properly balanced water conditioning program which combines quality products with correct, technically supervised control methods and test procedures.

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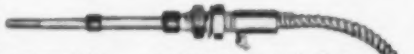
ACCURACY is inherent in the basic design, and in the standards of quality and precise dimension that control the manufacture of TRU-LAY PUSH-PULL CONTROLS. These are precision products, not gadgets.

VERSATILITY of this fine remote control can best be illustrated by citing some of the jobs it handles well . . . **HOT** jobs on jets and industrial furnaces . . . **COLD** jobs down to —70° F. . . . **WET** jobs (the conduit can be completely immersed) . . . **DIRTY** jobs . . . **ABRASIVE** jobs . . . **CORROSIVE** jobs . . . **HEAVY, TOUGH** jobs up to 1,000 lbs input . . . **LIGHT DUTY** jobs . . . **REMOTE** jobs 150 feet or more from the control point . . . these units are frequently and successfully used in conjunction with electric, hydraulic and air controls . . . are thoroughly effective under almost any operating condition.

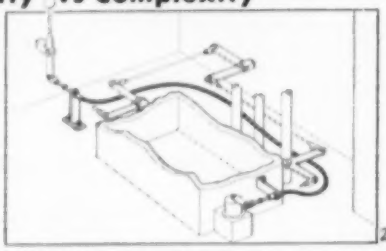


"SOLID as a rod but FLEXIBLE as a wire rope" aptly describes TRU-LAY PUSH-PULL CONTROLS. This *flexibility* provides positive, remote action whether anchorages are fixed or movable . . . it damps out noise and vibration—protects delicate instruments . . . it permits ease of handling and shipping even when assemblies are 100 or 150 feet long . . . it avoids the risk of damage always present with solid tubular controls that must be preformed to position . . . and flexibility greatly simplifies installation of controls by reducing the number of working parts and by making it possible to snake around obstructions. . .

Advantages of Tru-Lay Push-Pull flexibility and simplicity are pictured below

Simplicity vs Complexity

Compare the TRU-LAY PUSH-PULL cable in illustration with the mechanical linkage. PUSH-PULLS are simple, have but one moving part, are noiseless and give lifetime service accuracy. Linkages are complex, made of many parts; they wear at many points. Their use brings increased backlash, lost accuracy and vibration rattles.



ADAPTABILITY to all sorts of mechanical situations explains, in large measure, the wide-spread application of TRU-LAY PUSH-PULLS. Standard anchorages, fittings and heads have been designed that meet requirements on approximately 80% of the installations. Simple modifications of these standards, or minor changes in your own design, cover almost every special situation. Our engineers have the know-how on such matters.

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Whether your interest is in a single application of this versatile PUSH-PULL CONTROL, or in its inclusion as a component of the product you manufacture, the six booklets and bulletins in this **DATA FILE** will answer your further questions, and will also provide you with the means of defining to us the application you may be interested in.

The six bulletins and booklets in the DATA FILE will answer all your further questions. Write for your copy.

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AMERICAN CHAIN & CABLE

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Engineering Books

continued from page 126

Manufacturers' views on the selection of insulation level and impulse-voltage tests for power transformers.

To meet this need this present booklet has been prepared by the BEAMA Transformer Technical Committee based on its studies and reports given in recent years. In due course this publication will be superseded by a revised edition of BS 171, Electrical Performance of Transformers for Power and Lighting.

* * *

Abacs or Nomograms, by A. Giet. Size 6 by 9 in., 225 pages including index, cloth binding. Published by the Philosophical Library, Inc., 15 E 40th St., New York 16, N. Y. Price $12.00.

Most engineers have made use of nomograms at some time in their careers, and are fully aware of the fact that they are a very convenient tool when the same formula has to be solved repeatedly for several sets of variables. It is fair to say, however, that only a small proportion of even those who habitually employ nomograms know how to construct them for their own use.

The present work is essentially practical, and not only demonstrates the many varied applications of the abac or nomogram, but shows how even those without highly specialized mathematical knowledge may construct their own charts. It deals with both Cartesian abacs and alignment charts, and contains a large number of practical examples drawn from the fields of mechanics, physics, and electrical engineering. Very few formulas are outside the scope of nomograms if skillfully chosen auxiliary variables are introduced.

This book has been translated from the original French by Miss Helen Phippen who holds degrees in both arts and science and specializes in technical translations.

* * *

The Art and Science of Protective Relaying by C. Russell Mason. First Edition, 1956. 410 pages, 8¾ by 5¾ in., cloth. Published by John Wiley & Sons, 440 Fourth Ave, New York 16, N. Y. Price $12.00.

Much of the material in this book has been used for several years as notes for teaching the subject in the power systems engineering course given by the General Electric Company. These notes were written because there was no suitable reference book available that properly presented the subject to the novice.

From the experience gained, notes were revised to improve their clarity and to add necessary explanatory material. Therefore, the material has been tested in the classroom and should prove useful, both as a reference for teaching the subject and for the purpose of self education.

The book assumes no prior knowledge or

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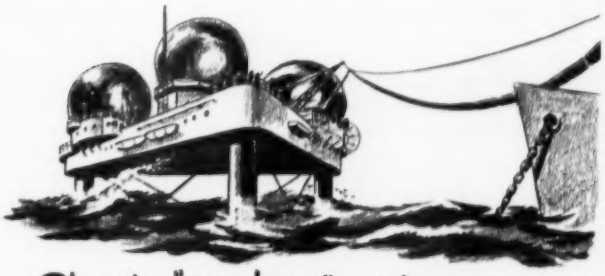

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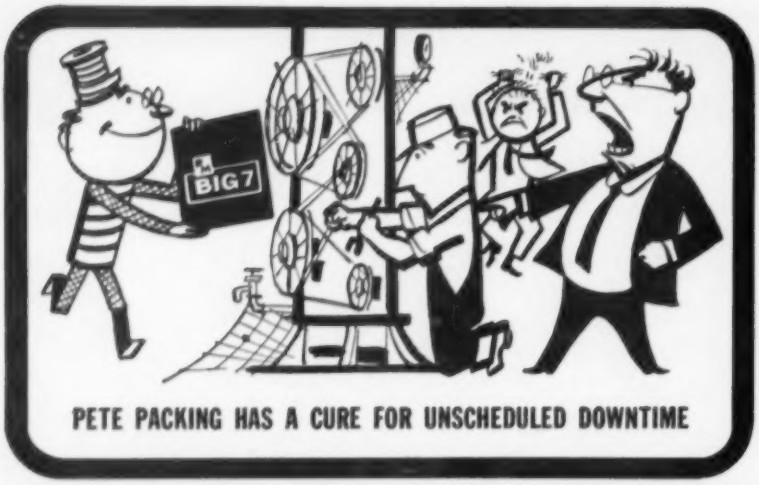

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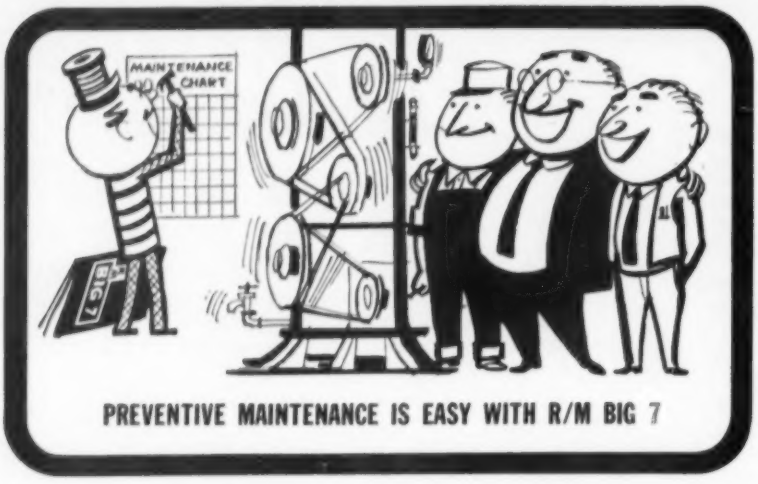

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Engineering Books

continued from page 128

protective relaying. In fact, as the student will quickly discover, one needs to know only the fundamental principles of electrical engineering to become well acquainted with protective relaying.

In spite of the elementary nature of the book, it should also be useful to the practicing and relay engineer. The book contains new material, it treats many subjects in a different manner from that found elsewhere, and it may help many to understand better what they already know. In addition, the book contains a large number of references to basic source material that has been found to be most authoritative and useful.

In general, theoretical proofs have been avoided. References are given to source material containing proofs where such is considered necessary.

So far as it is possible to make it so, the book is timeless. It contains fundamental information that is applicable to present-day North American practice, but the nature of the material is such that it should be applicable whenever or wherever protective relays are involved.

* * *

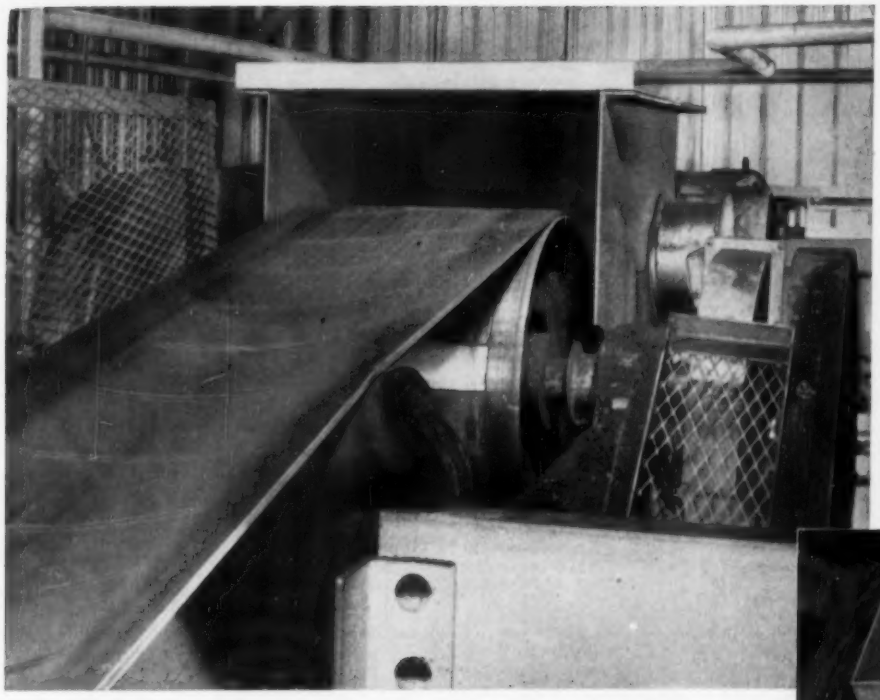
Basic Electricity, Laboratory Manual for Radio and Television Technicians, by Paul B. Zbar and Sid Schildkraut. First Edition, 1956. 84 pages, 8¼ by 11 in., paper. Published by McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y. Price $1.75.

This laboratory manual is one of a series developed by the Radio-Electronics-Television Manufacturers Association for use in vocational, trade and technical schools. In addition to this one there are similar manuals entitled Basic Electronics, price $1.75, and Basic Radio and Radio Receiver Servicing, price $2.00. Also available is an Instructors Guide designed to be used with the manual.

The manuals constitute a pre-employment course for beginners who wish to enter the fields of radio, electronics and television. The manuals set up a technical standard of knowledge and skills based on industry's needs. Thus the skills acquired are in demand by laboratories, factories and service shops.

The manuals provide a laboratory program closely correlated with recommended classroom instruction. By using up-to-date equipment and by following a logical sequence of jobs in which he learns basic technical skills, the student is taught electrical, electronic and radio principles which are applied in work on commercial products of the industry.

The objectives and required materials for each job are clearly set forth in simple language. The introductory information includes a short discussion of the theory and practice relating to that specific job. At the end of each job questions are given to test the students' knowledge of completed work. The jobs outlined were performed and the



Stearns permanent magnet pulley traps damaging tramp iron as coal for automatic boilers passes into pulverizer at head of 171-ft primary conveyor in coal transfer tower. Small photo shows iron collected in bin during one shift. Rated at 75 tons per hour, conveyor system totals 480 ft in two stages, normally handles up to 300 tons per day depending on coal delivery.

"Tramp iron is no problem,"

says Power Plant Superintendent

STEARNS MAGNETIC PULLEY PROTECTS COSTLY FEEDERS

Protecting costly crushers and feeder mechanisms in the coal-handling system at Milwaukee County Institutions, a Stearns permanent magnet pulley removes dangerous tramp iron before coal is delivered to the automatic boilers. Installed at the conveyor head in the coal transfer tower, the powerful magnetic pulley seizes iron junk in the moving load, deposits it safely in a bin for easy disposal.

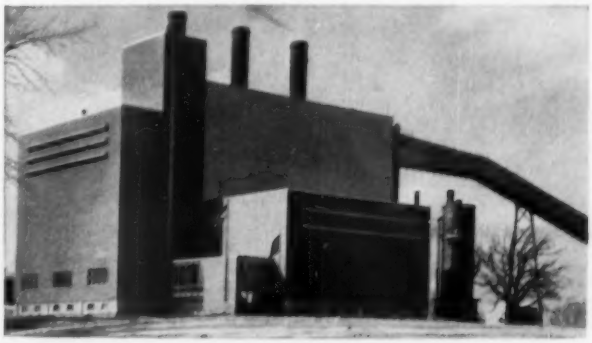
"Tramp iron is no problem in our coal-handling system," says Louis H. Winnard, Power Plant Superintendent. "The Stearns magnetic pulley does a thorough job.

"Before the coal conveying system was completed, we operated for a time without magnetic protection," recalls Mr. Winnard. "There was some difficulty with stray iron jamming in the stoker feeders, but we've had no trouble since then. Effective removal of tramp iron is a built-in feature of the system at Milwaukee County Institutions."

For positive protection from dangerous tramp iron, Stearns builds a complete line of electro and permanent magnet pulleys. Stearns specialists are ready to help you select exactly the right pulley for your system — a powerful, efficient unit *backed by 40 years of magnetic research, design and engineering experience.* Call your Stearns representative today or write for more information about Stearns magnetic pulleys. Ask for Bulletin 350-CM.

30

An outstanding example of modern power engineering, new power plant at Milwaukee County Institutions is designed for automatic operation, minimum supervision. The institutions are located on a 1,200-acre site in western Milwaukee County, Wisconsin, and comprise six medical care institutions of 6,000 beds housed in 80 buildings served by this power plant.



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One ounce of HTH per 1000 gallons of water is usually enough to control algae growths. Because algae growths form slowly, in most cases only a periodic "shot" treatment with HTH is necessary. This varies, of course, with the nature and condition of the specific water supply.

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Engineering Books

continued from page 130

techniques tested at the RETMA laboratory in the New York Trade School.

The manual on basic electronics and the manual on basic radio and radio receivers are of the same type as this one, and written by the same authors.

BOOKS RECENTLY RECEIVED *

Piping Stress Calculations Simplified by S. W. Spielvogel. Size 9 by 11 in., 193 pages plus index. Fifth Edition, published by S. W. Spielvogel, 15 Old Field Lane, Lake Success, N. Y. Price $5.00.

Basic Mathematics for Science and Engineering by Paul G. Andres, Hugh J. Miser and Haim Reingold. First Edition, 6¼ by 9¼ in., 846 pages, cloth. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price $6.75.

Laplace Transforms for Electrical Engineers by B. J. Starkey, 279 pages. Size 8¾ by 5¾, cloth. Published by the Philosophical Library, 15 East 40th St., New York 16, N. Y. Price $10.00.

Magnetic Materials in the Electrical Industry by P. R. Bardell. First Edition, 6 by 8¾ in., 288 pages, cloth. Philosophical Library, Inc., 15 East 40th St., New York, N. Y., 1955. Price $10.00.

Principles of Electric Utility Engineering by Charles A. Powell. First Edition, 6 by 9¼ in., 251 pages, cloth. John Wiley & Sons, Inc., 440 Fourth Ave., New York, 16, N. Y. 1955. Price $6.00.

Electro-Technology by M. G. Say. First Edition, 6 by 8¾ in., 166 pages, cloth. Philosophical Library, 15 E. 40th St., New York, N. Y., 1955. Price $6.00.

Principles of Nuclear Reactor Engineering by Samuel Glasstone. First Edition, 861 pages, 6½ by 9¼ in., cloth. Published by D. Van Nostrand Company, Inc., 250 Fourth Ave., New York, N. Y. 1955. Price $7.95.

Principles of Turbomachinery by D. G. Shepherd. First Edition, 463 pages, 9¼ by 6¼ in., cloth. Published by the Macmillan Co, 60 Fifth Ave, New York 11, N. Y. Price $10.00.

*** We suggest you check with publishers regarding prices, as some of these may have been changed.**

5 STEPS

in making an almost indestructible turbine

The rotor of a Terry solid-wheel turbine is a single forging of special composition steel. It is first rough turned in two operations, as shown, and then two cuts are taken to mill the semi-circular buckets from the solid metal. The wheel at the top has been finished, ready for mounting on the shaft. *The result is a single-piece wheel with no parts to loosen or wear out.*

Blade wear, which might occur after many years of usage, is not important, because the power-producing action of the steam takes place on the curved surfaces at the backs of the buckets. Thus wear does not materially affect horsepower or efficiency.

The blades can't foul. They have a one-inch clearance, and are further protected by the projecting rims at the sides of the wheel.

The Terry solid-wheel turbine is an extremely reliable piece of equipment. Write for details—today. Ask for a copy of bulletin S-116.

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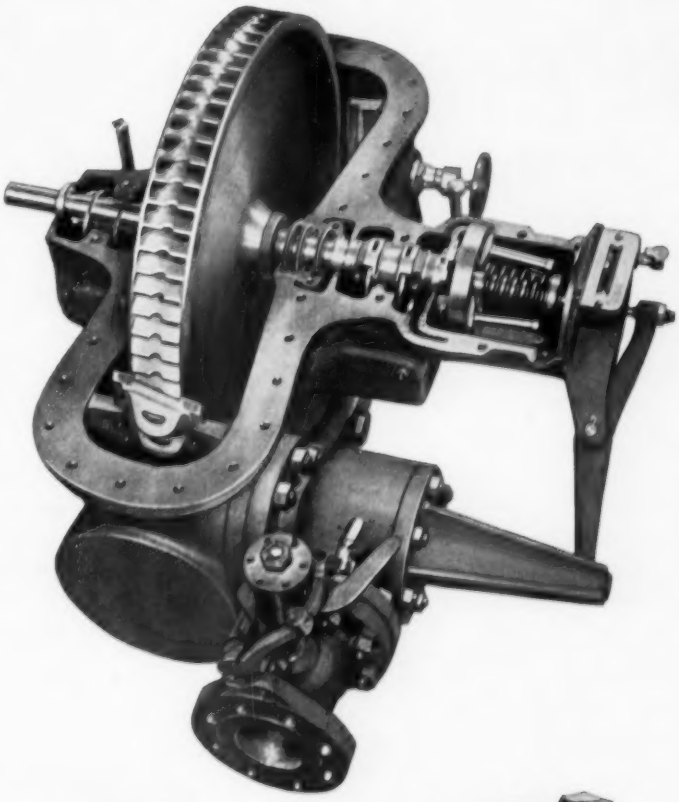

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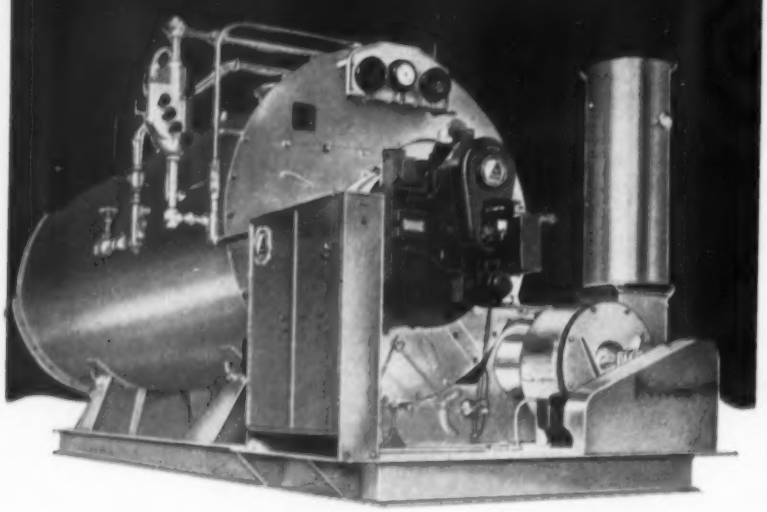

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The Preferred Unit Steam Generator has long stood so completely apart in general performance and life expectancy that every year sees its leadership lengthened and strengthened.

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Such painstaking care assures those who pay more initially that they will receive premium performance over more years, lower operating and maintenance costs, freedom from failures of major components—hence, lower eventual cost.

Catalog No. 2000 is a complete manual of basic considerations of fine boiler design and of the many exclusive features incorporated in the *Preferred* Unit Steam Generator.

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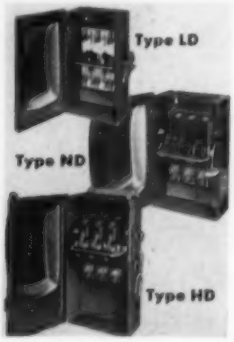
continued from page 58

31—SAFETY SWITCHES designed to meet NEMA standards

Three types are included in a line of safety switches recently announced as meeting the new NEMA specifications. Type LD is for light duty and replaces former D and G types. This line covers a range from 30 to 200 amp in general purposes and rain-tight enclosures. NEC horsepower ratings are included.

Type ND, for normal duty and commercial work, replaces former H, S, A or



C designations. The line extends from 30 through 1200 amp in 250 and 600 v, a-c and d-c, in general purpose or rain-tight enclosures. Both NEC and dual element horsepower ratings are included. This company's Type ND Switches include a quick-make, quick-break operating mechanism, independent of handle, and silver plated current carrying parts. These switches are reported to exceed UL endurance standards. Type HD for heavy duty industry use, is a premium performance switch. Enclosures include gasketed industrial (NEMA 12) as well as water-tight and dust-tight, and explosion-resisting types. It is claimed to exceed requirements as to safety. The Square D Co.

Reader Service Cards on pages 139–140 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

32—CENTRAL HUMIDIFIER automatically controlled

The Humid-i-maker is introduced as an automatically controlled, evaporative-type humidifier for smaller buildings with hot water, steam or warm air heating systems. It operates by circulating air across the surface of heated water and into a central distribution duct. The unit consists of a closed stainless steel tank containing submerged copper heating coils and a water-level control. A blower on the top of the tank circulates air. Hot water for the coils is pumped from a boiler or hot water heater. A humidistat

TOUGH, CORROSION-RESISTANT Lumnite Cement lining is ready for years of rugged service in coal hopper at Baldwin-Lima-Hamilton's Niles Tool Works Division, Hamilton, Ohio. Lumnite also has many refractory and heat-resistant applications throughout the power plant, from boiler to stack.

Concrete-lined coal hoppers give better service using Atlas LUMNITE* Cement

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- Placement is fast and easy — by pouring, plastering or guniting.
- Repairs are fast, and jobs are ready for service overnight.

For convenient placement of refractory concrete, Lumnite-base castables are pre-mixed, ready for use, and are made and distributed by leading manufacturers of refractories. For more information, write: Universal Atlas, 100 Park Avenue, New York 17, N. Y.

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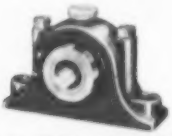

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- Flexidyne Dry Fluid Drives and Couplings. Bulletin A-640-A.
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- Roller Bearings. Load ratings, dimensions, etc. Bulletin A-638.

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controls both blower and hot water pump. Fill water is taken from the regular soft water supply.

The humidistat serves to maintain closely the degree of humidity set by the user. Large capacity is obtained by heating the water — air picks up more moisture from hot water. And since the moisture is evaporated, impurities and water droplets are not carried along, it is noted. The unit can be suspended from the ceiling or mounted on a floor stand. It includes covered tank, coils, float valve, blower, duct connection, humidistat and transformer-relay box, and comes ready for installation. Capacity of the Humid-i-maker is sufficient for up to 33,000 cu ft of space, it is announced. Armstrong Machine Works.

33—FLOWMETER measures hard-to-handle fluids

The VAF-Brooks Positive Displacement Flowmeter is reported suitable for hard-to-handle fluids such as bunker oils,

still bottoms and asphalt. The meter is available in sizes from 1 to 6 in. or up to 450 gpm capacity — temperatures to 660 F and pressures to 600 psi. Accuracies are given as ¼ per cent in 1 in. sizes, and ½ per cent in 2 to 6 in. size meters. Bulletin 400 gives more details. Brooks Rotameter Co.

34—EXPANDER CONTROL makes boiler tube rolling easier

Incorporated in the Model C Torq-Air-Matic, an air-powered tube-expander drive and control, is a dial to provide the control necessary for precise boiler-tube rolling. You set the desired torque (in foot-pounds) on the dial and start the rolling operation; when the desired torque is obtained, the expander automatically stops rotating. Joint tightness is always uniform, regardless of tube-sheet hole variation, it is claimed, and guesswork is taken out of tube expanding because the operator does not have to depend on expander resistance, motor sound, or "feel" to determine correct expansion. This feature is designed to make the tool easy to use and eliminate over- and under-rolling.

Model C is designed for a wide range of boiler tubes, from 1 to 2½ in. OD. Similar in principle to company's Model A Torq-Air-Matic, announced in 1956, the new model produces 75 ft-lb of torque — enough to roll 3-in. 10-gage tubes in a ⅝ in. thick sheet. An air hose is the only external connection. The Model C weighs 26 lb; it has a free speed of 200 rpm. Thomas C. Wilson, Inc.

35—BATTERIES feature rugged cell container material

Hi-Impac, a new material for industrial storage battery cell containers and covers claimed to virtually eliminate battery breakage, replaces present standard materials in this company's Slyver-Clad (R) line for industrial trucks and other uses. As a result of using Hi-Impac, damage to battery cells, from dropping, collision between trucks or impact of heavy objects falling on the battery, is practically eliminated, it is announced. C & D Batteries, Inc.

36—WEDGE CLAMPS designed for the power industry

This new intermediate line of service wedge clamps for the power industry is announced as the Series 7090 and takes a range of 0.400 to 0.250 in. Two other series numbers are already in the line, the 7080 series which takes a range from 0.260 to 0.160 and the 7082 series. The latter takes a range from 0.326 to 0.200 in. Reliable Electric Co.

37—DRILLING MACHINE is a portable, high speed unit

This high speed portable diamond drilling machine is announced for drilling holes in concrete, brick, granite, or any hard masonry material. Equipped with a Molco water swivel, this machine will drill 2 in. diam holes at up to 3 in. per min. Holes as small as 3/16 in. can be drilled with ease, company states, in the hardest of building materials. The flexible cable drive allows freedom for drilling holes in any position by plugging into a 110-v circuit. Powder Tool Fasteners, Inc.

38—U-BOLT CLAMPS serve a wide range of cable sizes

These heavy-duty U-bolt clamps, the 580 Series, employ universal, parallel spacer grooves and can be used on many cable sizes. The six clamps can be used

on ACSR from No. 2 to 715.5 mcm, and will also handle No. 2 to 800 mcm stranded aluminum conductor, company announces. All proportions — length of clamps, number of bolts, bolt sizes — are engineered for range of conductor size to be accommodated and job to be done. The U-bolt portion, flattened to reduce bulk, serves to provide wrap-around strength and even pressure distribution. Aluminum Co. of America.

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NOW Taper-Lock *Double* Strand Sprockets are available—from stock—ready for the shaft without re-machining!

They offer all the advantages of Taper-Lock mounting. Easy on! Easy off! Precision machined at the factory, they come to you with accurate, concentric bores—insuring full contact between hub and shaft. Taper-Lock grips with the firmness of a shrunk-on fit!

There is no flange, no collar, no protruding part. Flush design means *safety*... If the sprocket becomes worn, you replace only the tooth part. The bushing is used again and again. And Taper-Lock bushings are interchangeable in Dodge Taper-Lock Sheaves, Couplings and Conveyor Pulleys!

Taper-Lock Sprockets and Dodge Roller Chain (made to ASA standards) are stocked by Dodge distributors. Single Strand sizes range from No. 40 to No. 160, up to 112 teeth; Double Strand from No. 40-2 to 80-2, up to 102 teeth. Write for Bulletin A-644 containing selection, installation and maintenance data.

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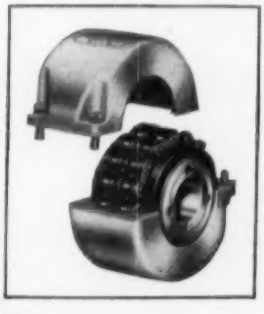

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WATER CONDITIONING

201 Water Conditioning Data Book — An excellent reference volume, Data Book 2478A contains 108 pp and presents a compilation of 78 chapters and tables. Subjects covered include hydraulics; impurities in water; chemical conversions; coagulant, acid and alkali dosages; chemicals used in water treatment; water treatment processes; boiler feed make-up requirements; alkalinity relationships; specific gravities; chemical reactions. Available to qualified power engineers, please state your job title when requesting this. The Permutit Co.

202 Steam System Treatment — This bulletin on Coravol for prevention of corrosion explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

203 pH and Chlorine Control — The 12th edition of company's handbook "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrite, sulfate, hardness and other tests. Slide comparators and complete test kits are illustrated. In addition to standard pH determinations, methods are outlined for quantitative analyses of phosphate, calcium, magnesium, silica nitrate hardness. Available to qualified power engineers. W. A. Taylor Co.

204 Ion Exchangers — Sixteen-pp Bulletin 1960-C, on ion exchangers, discusses the principles of cation and of anion exchange, and the practical operation of ion exchangers. General properties of company's ion exchange materials are given. A chapter is devoted to design features of manufacturer's ion exchange equipment. Several installations are illustrated. Infilco Inc.

205 On Demineralization — Technical Reprint T-140, 23-pp, a profusely illustrated article on demineralization, discusses advantages and disadvantages of this process for today's power plants. Developments, trends and applications of both multi-bed and mixed-bed ion exchange are considered, and several case histories cited. A comprehensive bibliography lists 119 separate items. Tables, flow sheets, descriptive drawings, performance curves, process selection charts included. Graver Water Conditioning Co.

206 Carbon Dioxide Measurement — Technical Paper 133, 16-pp, discusses determination of CO_2 in water by conductivity measurements. Describes a new method developed for the determination

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21	22	23	24			
25	26	27	28			
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41	42	43	44			
101	102	103	104	105	106	107
108	109	110	111	112	113	114
115	116	117	118	119	120	121
122	123	124	125	126	127	128
129	130	131	132	133	134	135
136	137	138	139	140	141	142
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150	151	152	153	154	155	156
157	158	159	160	161	162	163
164	165	166	167	168	169	170
171	172	173	174	175	176	177

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201	202	203	204	205	206	207	208	209	210	211
212	213	214	215	216	217	218	219	220	221	222
223	224	225	226	227	228	229	230	231	232	233
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245	246	247	248	249	250	251	252	253	254	255
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of carbon dioxide which is applicable to analysis of waterside deposits, treatment chemicals and organic carbon in water. W. H. & L. D. Betz.

207 **Water Treatment** — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

208 **Mixed-Bed De-Ionizers** — Practical equipment for mixed-bed de-ionization at flow rates of 5 gph to 5000 gpm is described in this 8-pp bulletin. Advantages of construction and design are detailed, as well as mechanical features, installation operation. Illinois Water Treatment Co.

209 **Corrosion Treatment** — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising the pH value of the condensate. The Bird-Archer Co.

210 **Feed Water Deoxygenation** — The advantages of chemical deoxygenation of boiler feed water with an aqueous solution of hydrazine are described in 12-pp Bulletin BW 5. How hydrazine serves to maintain boiler in cleanest possible condition, reducing iron oxide scale to a magnetic oxide, is fully detailed, and such considerations as economy and operation, handling precautions, containers and storage, and methods of analysis are covered. Fairmount Chemical Co., Inc.

COAL, ASH HANDLING

212 **Tractor Shovel** — The engineering, design and production stories of company's HD-11G tractor shovel are pictorially presented in 8-pp Catalog MS-460. Includes specifications and describes various features which mean easier servicing for less time-down and greater operator comfort. Allis-Chalmers Mfg. Co.

213 **Coal Crusher** — Company's WC and W8 series rolling ring coal crushers are described in Bulletin 154. Emphasizes special construction elements that mean greater coal reduction at lower operating costs. Cross section illustration shows both feeding and crushing action incorporated and tables give capacities, speeds, and dimensions. American Pulveriser Co.

214 **Improved Crushers** — Bulletin 12-C, 16-pp, describes company's line of crushers for reducing coal, coke, glass cullet, gypsum, lime, metal turning, sugar, sulphur and similar lump materials. Covers Knittel ring type crushers, two-stage double-roll crushers, single-roll crushers, and double-roll crushers. Photos, dimensional drawings and full specifications are included. Stephens-Adamson Mfg. Co.

BOILERS, GENERATORS

216 **Packaged Boilers** — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 40,000 lb per hour. Space requirements are shown in a table with specifications. Combustion Engineering, Inc.

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13	14	15	16	122	123	124	125	126	127	128
17	18	19	20	129	130	131	132	133	134	135
21	22	23	24	136	137	138	139	140	141	142
25	26	27	28	143	144	145	146	147	148	149
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33	34	35	36	157	158	159	160	161	162	163
37	38	39	40	164	165	166	167	168	169	170
41	42	43	44	171	172	173	174	175	176	177

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201	202	203	204	205	206	207	208	209	210	211
212	213	214	215	216	217	218	219	220	221	222
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501	502	503	504	505	506	507	508	509	510	511
522	523	524	525	526	527	528	529	530	531	532
543	544	545	546	547	548	549	550	551	552	553
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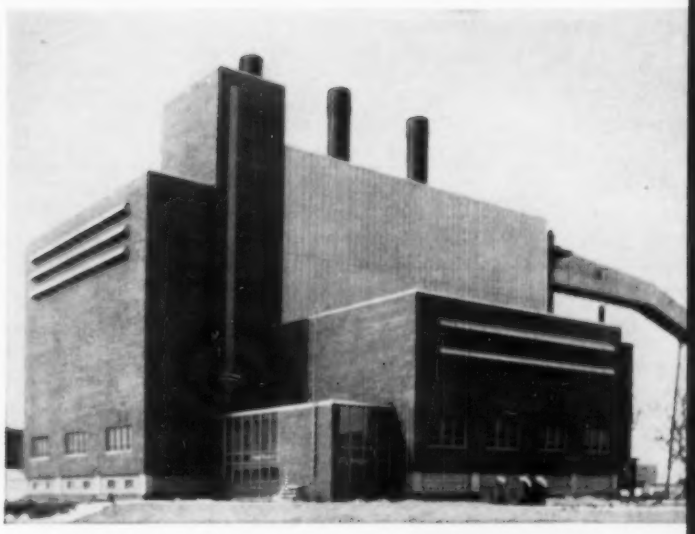
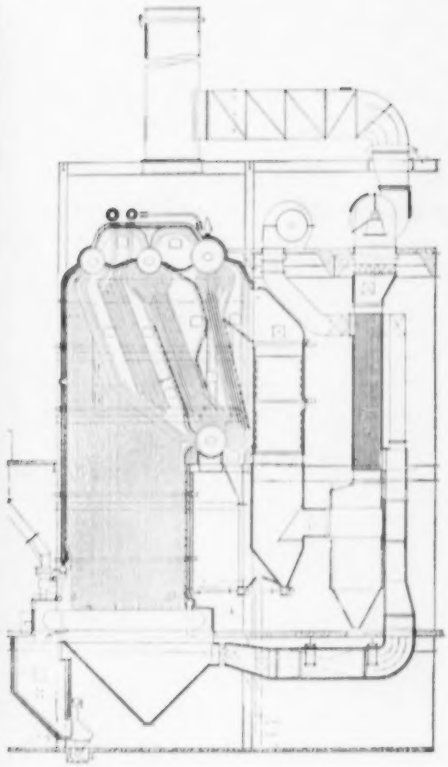


Power Plant, Milwaukee County Institutions



Longitudinal Section of Union Type B Boiler

Union Boiler Trio scores 86.52% in efficiency test at Milwaukee County Institutions

Grouped on a 1200-acre tract, Milwaukee County Institutions have the self-sufficiency of a small community. With 4 hospitals, a sanitarium, children's home, administration building and nurses' home, this health and child-care center has its own fire department, bakery, laundry, garage and power plant. In all, there are 35,000,000 cu. ft. of buildings providing complete facilities for 6000 patients and 3100 employees.

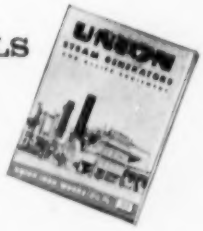
Three Union 4-drum, Type B Boilers handle the entire steam demand for space heat and electrical power. Each has a continuous capacity of 110,000 lbs./hr. at 625 psig and 745° F. *The institutions have no other source of heat or power!*

Job-tested at an average individual output of 110,934 lbs./hr., this Union boiler team has topped performance guarantees with an 86.52% efficiency rating. *Economy of operation has been clearly substantiated!*

This is one of many installations supplying "proof-through-use" evidence of Union efficiency and dependability. Serving industrial, institutional and public power plants, Union Boilers are widely known for their ability to measure fully up to expectations.

GET FULL DETAILS

Make sure that you are acquainted with the several types of steam generators built by Union by writing for illustrated Catalog GB-153.



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217 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-type boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Erie City Iron Works

218 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

219 Steam Generators — Bulletin 55-1, 22-pp, describes company's products and services, including not only steam generators but also custom metal fabrication. There are many photos of boilers in various stages of assembly. Engineering drawings of boilers producing up to 500,000 lb of steam per hr on standard fuels are included, as well as illustrations of units for waste heat application and those designed to utilize refuse for fuels — wood chips, coffee grounds. The Wickes Boiler Co.

220 Standard Generators — Bulletin B-55-4 describes company's SC economy series of standard steam generators designed to reduce steam costs for industrial plants. Pre-engineered, standardized steam generators offered in nine sizes, with capacities of from 50,000 to 150,000 lb per hour are described, and schematic and cutaway drawings of the units and illustrations of design features are included. Foster Wheeler Corp.

221 Water Tube Boilers — This 12-pp catalog describes packaged water tube boilers, in capacities from 8000 to 50,000 lb per hour. Interesting as well as informative, this booklet uses color and illustrations to amplify text. Gives complete data and dimensions for boilers designed for firing oil or gas or both. Superior Combustion Industries, Inc.

222 Shop Assembled Boiler — Sixteen-pp Bulletin G-76 completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. The Babcock & Wilcox Co.

223 Packaged Generators — Bulletin MH 3-54, 14-pp, gives detailed coverage to company's Type MH packaged water tube steam generators which are furnished for oil or gas firing or both, with automatic, semi-automatic, or manual controls. Included are: cutaway illustrations, installation photos, tube arrangement layouts, construction details, auxiliary equipment, dimensions. Union Iron Works.

TUBING AND ACCESSORIES

224 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

225 Life Extension for Condenser Tubes — The 32-pp current edition of this booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

226 Tube Tools — Eight-pp Bulletin 58 describes advantages and application of company's line of tube cleaners, tube expanders and maintenance tools, including drills, brushes, accessory and specialty tools. Photos are included as well as size and selection data. Airetool Mfg. Co.

227 Heat Exchanger Tubing — Cited in this 30-pp catalog are typical cases where cupro-nickel or Monel tubing installed in heat exchangers resulted in substantial savings and better efficiency through longer tube life. Describes applications of this tubing in various instances where unusual water conditions, as to pollution, excessive turbulence, temperature and the like, required tubing that would withstand this rigorous wear. The International Nickel Co., Inc.

228 Tube Expanders — Catalog 88, 119-pp, is full of detailed information about tube expanders and associated tools used for tube rolling. Profusely illustrated, catalog provides information relative to boilers, condensers, evaporators or miscellaneous heat exchangers. Special sections are devoted to expanders, accessories, measuring instruments, rollers, extensions and drives. Each type of equipment is fully described, applications are listed, and tables of engineering data included. Also covers tube expansion methods, tool maintenance, expansion calculations and charts giving sizes. Thomas C. Wilson, Inc.

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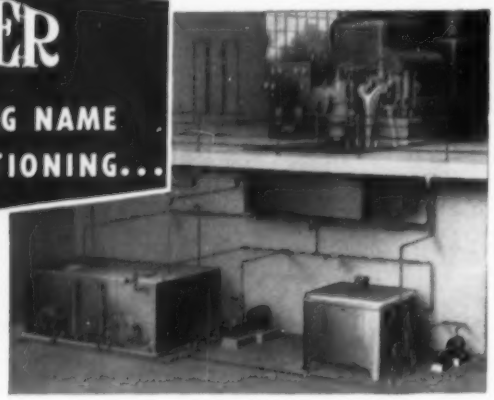

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A NEW METHOD OF ION-EXCHANGE THAT PRODUCES BETTER QUALITY EFFLUENT AT LOWER COST

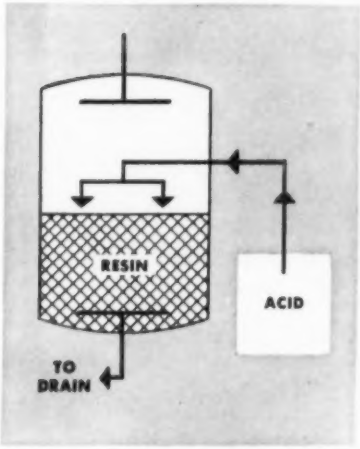

FIG. 1 CONVENTIONAL REGENERATION

It has been recognized that breakthrough of ions, chiefly sodium, occurs in conventional ion-exchangers, causing a contamination of the effluent. This is due to layered retention of some metallic ions in the resin bed during normal operation. Studies show that these layers consist of Ca^{++} ions near the upper part, Mg^{++} ions in the middle, and Na^{+} ions through the lower part of the resin bed. Conventional regeneration does not completely remove the bottom layer of sodium ions. When back on service, these sodium ions are then kicked out and appear as contaminants of the effluent.

Many efforts have been made to overcome this undesirable situation, with limited success. *Now, at last, Illinois Water Treatment Company has discovered and developed a corrective method which has been thoroughly tested and has proved consistently and fully effective.*

The conventional method of regeneration is shown diagrammatically in Fig. 1. One form of the new ILLCO-WAY method is shown in Fig. 2. The principal feature of the new ILLCO-WAY method is the upward passage of the regenerant, combined with some form of barrier to keep the resin bed from expanding. Previous attempts at upward regeneration failed because the low-density resin materials now commonly employed have a tendency to expand and channel. The result was a very inefficient regeneration. Increased concentrations of the regenerant only added to costs without significantly improving the results.

Actual installation experience with the new ILLCO-WAY method shows an almost complete elimination of sodium contamination uniformly throughout each run. Fig. 2 illustrates one type of barrier that may be employed, namely, a downward pressure of water which keeps the resin bed from expanding. The mixture of water and regenerant is drawn off by a distributor located near the resin face.

If the purity of the effluent from your de-ionization equipment is not satisfactory, we suggest you discuss immediately, with your Illinois Water Treatment representative, this new and effective method of correcting it.

REPORT FROM A TYPICAL INSTALLATION

An existing conventional two-bed ion-exchange installation in Nebraska was converted to the new method described above. A study of results and operating costs over a six-month period shows a substantial improvement in the purity of the effluent (from a conductance of 25-5 micromhos to 6-0.5 micromhos) and a great reduction in cost of regenerants (from 7.34c per 1000 lbs. of effluent to 3.51c).

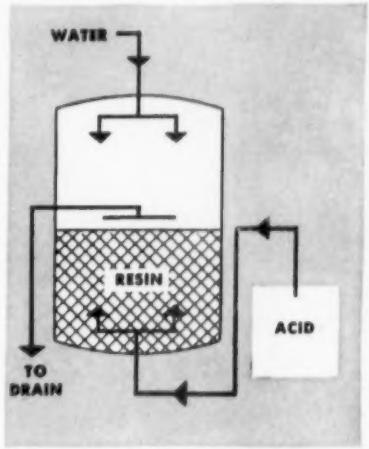

FIG. 2 COUNTERFLOW REGENERATION

* "COUNTERFLOW" is the trademark of Illinois Water Treatment Company equipment utilizing a distinctly new principle of regeneration. Patent pending.

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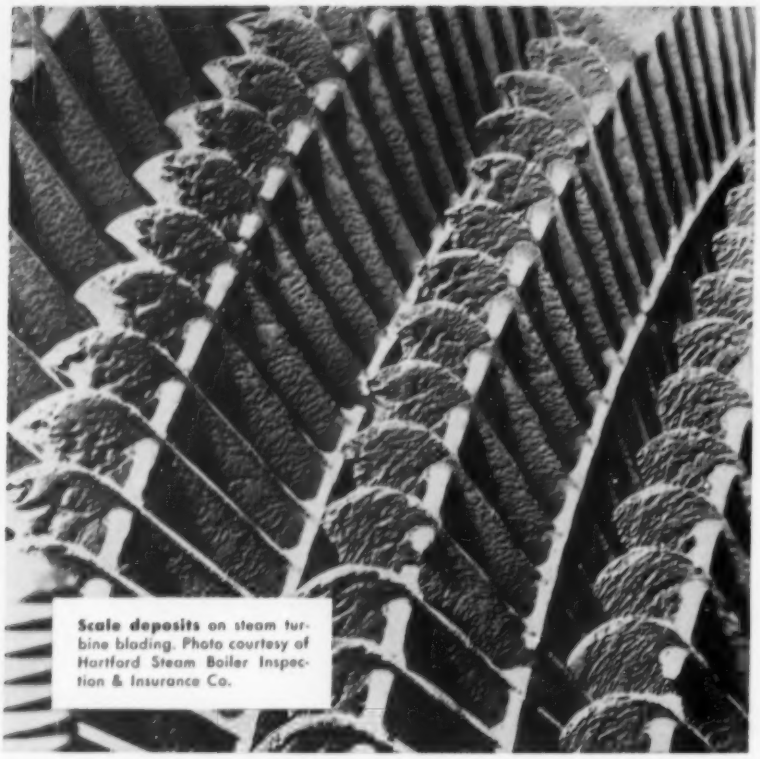

Scale deposits on steam turbine blading. Photo courtesy of Hartford Steam Boiler Inspection & Insurance Co.

No Build-Up! No Blow-Up!

. . . WHEN MODEL 1106 PROPORTIONEER FEEDS BOILER WATER CHEMICALS

Prevent scale build-up (caused by boiler carry-over) on turbine blades with proper raw water or internal steam boiler treatment. Model 1106 Proportioneer feeds all chemicals (alkaline, neutral, or acid) accurately (guaranteed within ±1%) over 15 to 1 range. Capacities range from 0.11 to 35.6 GPH . . . for discharge pressures up to 1100 psig.

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Design features of this proportioning pump include interchangeable measuring cylinders, super-accurate Vane-Guide check valves, and percentage calibrated stroke-length scale.

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PUMPS AND PUMPING

229 Controlled Volume Pumps — Bulletin 953, 24-pp, describes and illustrates use of controlled volume pumps in industrial water treating systems. Construction and operation features are described, capacity-pressure ranges and speed and stroke length adjustments are charted. Typical chemical feed and water treating systems are presented through text and diagrams; and an analysis of boiler water treating systems, cooling water treating problems, and systems for waste and sanitary water treatment included. Milton Roy Co.

231 Meter that Pumps — Bulletin 300, 8 pp, describes company's improved meter that pumps — designed for precise metering and proportioning of small quantities of low viscosity fluids at low cost, over extended periods of time. Complete capacity tables and a detailed schematic are also included. Hills-McCanna Co.

232 Solids Handling Pumps — Bulletin 121-A, 8 pp, describes a complete line of non-clog pumps for handling solids in suspension. Included are vertical, horizontal and close-coupled types used to handle liquid components of industrial processes, industrial waste, and for such pumping applications as water supply, drainage and sewage handling. Specifications are included. Aurora Pump Div., The New York Air Brake Co.

PACKINGS, SEALS

233 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing applications. Packing Div., Raybestos-Manhattan, Inc.

234 Mechanical Seals — Bulletin S-205-2, 8-pp, covers the complete line of chemically inert mechanical seals for handling all types acids, corrosives, solvents and gases. Provides construction, service and application information, installations and engineering details. Crane Packing Co.

MECHANICAL POWER TRANSMISSION

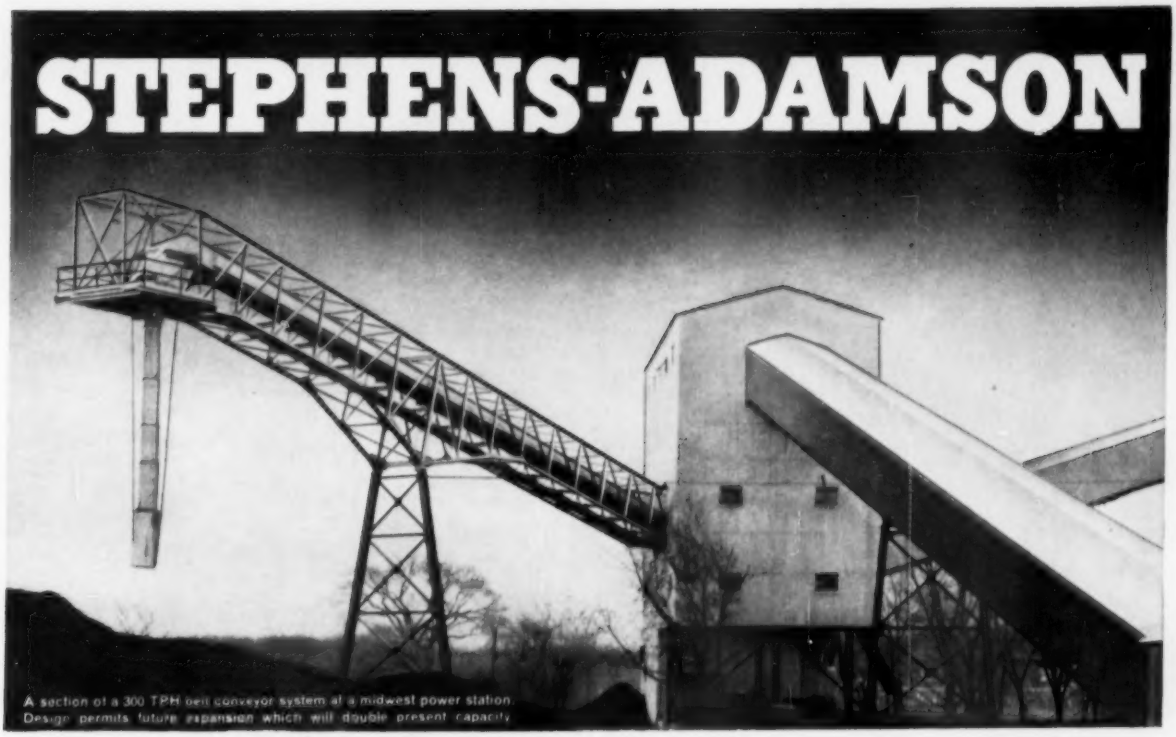
235 V-S Drive Selection Tips — Bulletin 20P50, 44 pp, carries handy multicolor tables for quick and easy selection of variable speed Texrope drives. In addition to providing these tables for A, B, C and D section variable speed drives, booklet includes information on design features, drive principles, horsepower rating tables, speed range table. Allis-Chalmers Mfg. Co.

236 Speed Reducers — Design and operation advantages of company's line of Torque-Arm speed reducers are outlined in 28-pp Bulletin A-637. Includes selection tables for double and single reduction units, bore dimensions and bushings, data on overload releases, flange mounted speed reducers, and recommended V-belt drives. Dodge Mfg. Corp.

LUBRICANTS

238 Lithium Soap Greases — This product information bulletin details qualities and specifications of company's multipurpose soap industrial greases. Advantages of multi-purpose grease use — such as prevention of lubricant misapplication, simplified maintenance procedures

STEPHENS-ADAMSON



A section of a 300 TPH belt conveyor system at a midwest power station. Design permits future expansion which will double present capacity.

for mechanized economy in coal conveyor systems

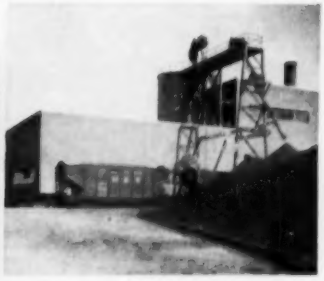
Moving coal from a receiving point to combustion at lowest possible cost is a vital problem in central power stations, private industrial plants, service institutions—wherever coal is used for steam generation.

The trick in the moving is knowing how to apply modern, scientific conveying equipment to any given set of conditions. How will coal arrive at the plant? What are generation requirements? What specific types of handling equipment are needed? What are storage needs inside and out? STEPHENS-ADAMSON engineers probe the problem all the way. These same men know there is no such thing as a "typical" power plant conveyor system. It must be designed purely to meet existing conditions and with plenty of foresight for future demand.

To provide the tools the engineer needs, STEPHENS-ADAMSON manufactures a complete line of coal handling equipment. It is a quality line designed from long experience, built to last for years of trouble free service.

For the ultimate economy in coal handling systems, see the STEPHENS-ADAMSON representative in your area. Learn why it pays to convey the S-A way.

An S-A system serves the needs of the Potomac Electric Power Co., Washington, D. C. Existing facilities have been designed with provision for ultimate 493,000 KW output. This is a typical example of how Stephens-Adamson engineering provides for future power expansion needs.



Brantly Steam Station, Danville, Va., is served by an S-A conveyor system. Compact REDLER conveyor-elevators are used to good advantage to convey coal to silo and stockpile storage. A pan feeder serves to move coal from track hopper and also reclaims from storage pile.

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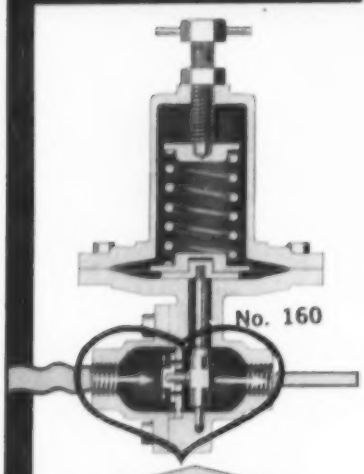

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For interesting facts, write for Bulletin J-160.

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are discussed, together with performance characteristics. Sinclair Refining Co.

239 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, uses, properties. Standard Oil Co. (Ind.)

240 Bearing Lubrication — Vol. XL, No. 10 of this company's Lubrication magazine provides an excellent 12-pp article on industrial bearing lubrication. Illustrated with photos and drawings, text covers such subjects as bearing design; bearing surfaces; bearing overhaul; aspects of lubrication, including factors involved, in choice of turbine oils and diesel lubricants, and the deleterious effects of moisture; and the life expectancy of bearing lubricants. The Texas Co.

INSTRUMENTS, CONTROLS

241 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feedwater. Copes-Vulcan Div., Blaw-Knox Co.

242 Instrument Panels — Power and process plants can choose instrument and control panels to meet individual specifications from six standard designs described in 16-pp Product Specification G71-7. Complete specifications are furnished, as well as information on supports and mountings for tubes, wires and equipment, instrument mounting dimensions, and dimensions of standard instrument and control panels. Bailey Meter Co.

243 Oil Leak Detection — Eight-pp illustrated Bulletin 80, on the Paraprobe oil leak detection system for steam-type fuel oil heaters gives a detailed explanation of the operation of the system. Provides installation diagrams, standard specifications, explains determination of condensate flow rate. Davis Engineering Corp.

244 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

245 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

246 Solenoid Pilots — Several types of solenoid pilots for use with company's regulating valves are described in Form 1010. Lists reasons for economies in on-off control, describes applications, and gives type of pilot, material of construction, maximum pressure and maximum temperature for two- and three-way pilots in

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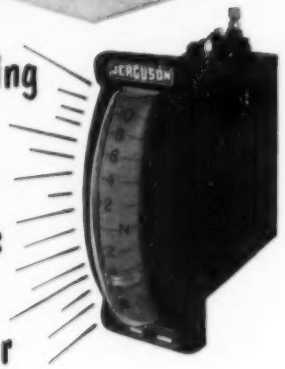

Jerguson Truscales are now available with a unique new safety feature. Illuminated scale starts flashing red if boiler water level gets too high or too low. This positive warning flashes continuously until the dangerous condition is corrected.

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steam, gas and liquid service. Schematic diagrams of typical applications are given. Spence Engineering Co., Inc.

247 Control Fundamentals — Three important factors in combustion control — safety, efficiency and long life — are considered in detail in 16-pp Form EB-1-755, the first of a series. Reviews basic concepts involved in automation in combustion, or the provision of automatic means for sensing heat requirements to assure correct proportioning of fuel and air under optimum conditions. Fundamentals of controls common to all systems are covered. Cleveland Fuel Equipment Co.

248 D-C Amplifier — Twelve-pp Bulletin MSP 111.1 provides pictorial diagrams and descriptive information on company's PowrAmp Model P, an electronic low-voltage linear amplifier designed to increase the speed and accuracy of low level d-c voltage measurements. Discusses performance and construction features of the amplifier and describes some applications. Hagan Corp.

249 Ideas on Push Pull Controls — Included in this "Idea File" are answers to a power engineer's questions on the use of push-pull controls. A general information booklet discusses remote control applications, explains construction and operation of company's Tru-Lay controls. Separate bulletins are devoted to standard assemblies, bracket-type head controls, micro controls and hand-operated controls. Automotive and Aircraft Div., American Chain & Cable Co., Inc.

250 Sampling System — A newly developed system for continuous sampling and oxygen measurement of combustion processes is described in Bulletin 703. Points out advantages of system and diagrams component parts. Selection of sampling tube and gas selector units is discussed. Arnold O. Beckman, Inc.

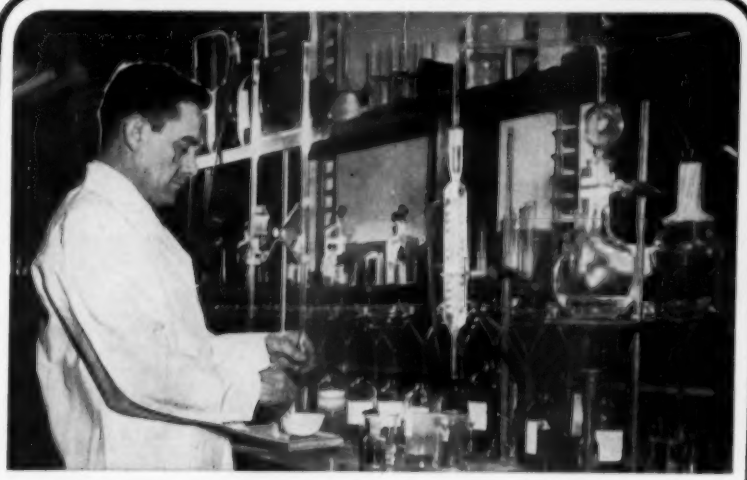
Do any of these catalogs answer your operating or maintenance needs? Let us know by circling the number of the catalog on the post card provided on page 139. We'll do the rest!

251 Bi-Color Gage — Bulletin 1174 gives advantages of company's Multi-Port bi-color gage made for boiler operating pressures to 3000 psi. Points out chief design features, illustrates construction details through photos and drawings. Diamond Power Specialty Corp.

252 Remote Reading Gages — Eight-pp Catalog 291, revised, shows new designs in remote reading liquid level gages, including the Red Flasher Truscale. This has a scale which flashes continuously in red for a positive warning when boiler water level gets too high or too low. Profusely illustrated with photos and engineering drawings, catalog covers gages in four pressure groups from under 900 to over 1500 psi. Jerguson Gage & Valve Co.

ELECTRICAL EQUIPMENT

254 Testing Instruments — Bulletin 19-57, 16-pp, features company's electrical testing instruments, including ohm-



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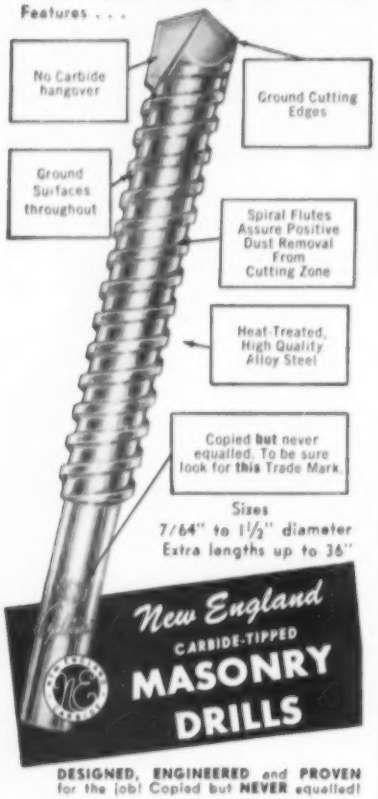
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meters, ground testers, dielectric test sets, motor rotation tester, cable fault locating equipment, transformer turn ratio test sets, corona test equipment, frequency meters, tachometers, others. Includes photos and descriptions of each type, including chief features, operating ranges, and applications. James G. Biddle Co.

255 Industrial Systems — Bulletin GED-3039, 48 pp, gives information on distribution system planning. Features, advantages, application, operation and other data on system-engineered equipment for industrial power distribution, including switchgear, unit substations, switchboards, transformers, busways, wire and cable, conduit products, voltage regulators, capacitors, circuit breakers, safety switches, panelboards, controls, motor controls, motors, turbines, rectifiers, and wiring devices are covered. General Electric Co.

256 On Copper Conductors — Publication C-25, 62 pp, is designed to help make the selection of bus conductors easier. Included in booklet are tables regarding such shapes as channels, ventilated square tubes and round tubes. There are tables for other rigid bus conductor shapes, also data on bare copper wire and cable as well as commonly used alloy wires. Also provided is a general discussion of copper, its physical and electrical properties. Photos illustrate many installations. The American Brass Co.

257 Selecting Protective Devices — The Protection Handbook, 24 pp, is based on the 1956 National Electrical Code, and interprets this code into easily read form. It covers the selection of protective devices for electric circuits, motors, appliances and apparatus, and includes a list showing the size to use when ordinary fuse, Fustron dual-element fuse or Fustat is installed. All information is condensed. Fully illustrated, book gives wiring diagrams, motor tables. Bussman Mfg. Co.

VALVES, TRAPS, PIPING AND ACCESSORIES

258 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

259 Lubricated Plug Valves — Catalog PV-24, 36-pp, shows in detail a line of iron and steel lubricated plug valves. Many illustrations of the single, screwed and bolted gland type valves are shown, including photos, sectional and detailed drawings. Also included is physical data on dimensions. The Wm. Powell Co.

260 General Purpose Valves — Supplement No. 1 to Catalog F-9, 32-pp, offers complete information on company's series of general purpose drop forged steel valves, gate, globe and angle types, sizes ¼ through 2 in. Includes descriptions of each type along with drawings showing component parts. Dimensions and other specifications are tabulated, and a pressure-temperature ratings table is included. Henry Vogt Machine Co.

261 Diaphragm Motor Valve — Bulletin J-170 describes outstanding features of company's diaphragm motor valve designed for accurate control of pressure, temperature, rate of flow, and liquid level.

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Cutaway view showing component parts is included, along with data on materials of construction, capacity tables, and flow diagram. The Jordan Corp.

262 Boiler Blow Off Valves — Bulletin E-125, 24 pp, describes and illustrates the design and construction of company's quick-operating valves, angle valves, Y valves and duplex units specifically designed for boiler blow-off service. Includes dimensions. Everlasting Valve Co.

263 Water Hammer Control — Cause, effect and control of water hammer in piping systems is the subject of 8-pp Bulletin WH 851. Photos, drawings and curves supplement text, and test data is presented to show efficiency of company's silent check valves in water hammer control. Some typical installations are illustrated. The Williams Gauge Co., Inc.

264 Valve Chart — Form 194, 22 pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure numbers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio Injector Co.

When ordering catalogs, allow time for us to relay your requests to the manufacturers—and for them to mail out copies. Remember, manufacturers are often swamped with catalog requests.

265 Air Release Valves — Bulletin 856 covers air release valves for venting air from hot water heating systems, venting air from chilled water cooling and air conditioning systems, and releasing air from industrial and municipal pipelines and other equipment as water mains, water filters, tanks, brine lines, etc. Describes operation, lists features, and gives specifications and capacities, as well as typical installation drawings. The V. D. Anderson Co.

266 Valve Charts — Now available to power engineers are three well-organized wall charts on valve types, selection and protection. "How to know valves" covers four main types of valves from the standpoints of their appearance, inside construction, service intended, operation and use. "How to select valves" discusses five major factors involved in the choice of a valve — fluid, temperature, pressure, size and function. "How to protect valves" — written in "do and don't" style covers 11 important points in valve installation, operation and maintenance. R-P & C Valve Div., American Chain & Cable Co., Inc.

267 Choosing the Right Valve — Presenting valve selection as a matter of matching the valves's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are discussed and illustrated. Crane Co.

268 Steel Gate Valves — Four types of Hancock general purpose steel gate valves for process and power piping systems are described in illustrated Bulletin

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202 C, 12 pp. Material specifications, dimensions given, also service pressure ratings. Manning, Maxwell & Moore, Inc.

269 Valve Data — This loose-leaf notebook contains a collection of company's bulletins on its line of valves for control of air, gas, liquids and solids. It features complete operating, design, dimensional and specification data on butterfly, slide, automatic and proportioning valves, and is profusely illustrated with photos, drawings and diagrams, highlighting valve design and construction. W. S. Rockwell Co.

270 Industrial Valves — Condensed Catalog 105, 28-pp, contains data on valves for a wide variety of applications. Includes dimensions and illustrations describing non-return (stop-check) valves, globe and angle stop valves, pressure seal design, angle univalves and small size globe valves designed for chain or extension operation in vertical lines. Also included is company's Mudwonder valve for abrasive fluids. Edward Valves, Inc.

271 To Get at Those Valves — This little folder describes a sprocker rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

272 Flexible Ball Joint — Catalog 215-B, 20-pp, describes advantages of company's flexible ball joints for use in piping for power, process, heating, chemical, construction, or hydraulic service. Includes engineering specifications and data on the standard 300 lb series and the series 600. Screwed, flanged and welding end joints are listed, as are insulating joints and jacketed joints for handling asphalt and other liquids that solidify unless heated. Barco Mfg. Co.

273 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, as well as trouble-shooting and repair. Armstrong Machine Works.

274 Steam Trap Selector — Twelve-pp Bulletin T-9 is designed specifically to aid in selection and application of steam traps on chemical processing equipment. Features a foldout piping diagram for 22 pieces of typical processing equipment — each showing recommended steam trap and piping arrangements. Also contains selector tables. Yarnall-Waring Co.

REFRACTORIES, INSULATIONS

275 Insulations, Refractories — This 20-pp catalog features thermal insulations and refractories for general industrial applications. Organized for quick reference, catalog provides information on composition, physical and thermal properties and sizes of the various products. Lists chief advantages, covers materials for efficient control of temperatures from −400 F to 3000 F. Johns-Manville.

276 Refractory Concrete — Basic information on recommended practice for mixing and placing refractory concrete, used in the metal, power, ceramic, and petroleum refining industry as a material to withstand service temp to 2600 F or more, is presented in this 16-pp manual. Sections are devoted to special properties of refractory concrete, aggregates, refractory insulating concrete, and structural design. Universal Atlas Cement Co.

277 Refractory Cement — Heavy duty brick bonding and patching mortar is described in this 8-p illustrated color folder. Includes success stories concerning the product's application in high temperature work and in the protection of equipment against slag, fly ash and gases. Refractory and Insulation Corp.

278 Refractory Castable — Bulletin R-40 describes use of Kaocrete-32, a high temperature refractory castable, in boiler ashpits. A discussion of various methods of ash removal, along with maintenance problems peculiar to each, is presented. Four typical installations are detailed. Refractories Div., The Babcock & Wilcox Co.

FUEL BURNING EQUIPMENT

279 Oil and Gas Burners — Bulletin OB-53 28 pp gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. The Engineer Co.

280 For Burning Refuse Fuel — This 8-pp bulletin describes refuse fuel burning equipment, including a pneumatic refuse fuel distributor which spreads refuse fuels such as bark, wood chips, and bagasse uniformly over the grate surface. Discusses construction features of various components. Riley Stoker Corp.

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281 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces where steam or compressed air is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

OTHER EQUIPMENT

282 Product Guide — Manufacturing facilities for company's line of steam turbines, turbine generators, ship propulsion units, feed pumps, centrifugal compressors, blowers, centrifugal pumps, reduction gear, and other products are described in this profusely illustrated 50-pp catalog. Photos show manufacturing procedure involved in the work. De Laval Steam Turbine Co.

283 Steam Turbines — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multistage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Turbine Co.

284 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered in this informative booklet. Air Preheater Corp.

Bulletins reviewed here are offered primarily for qualified power engineers. Manufacturers may withhold literature from persons who do not state their job title and company. Some manufacturers also prefer not to send literature to those in foreign countries in which they have no sales representatives.

285 Steam Condensers — Advantages and features of company's line of steam condensers are detailed in this 24-pp catalog which pictures actual installations in typical power plants. Design data and an engineering section providing information on heat transfer rates, pressure drop, and other factors are included. Other sections cover air removal equipment, maintenance, and steam condenser specialties. Condenser Service & Engineering Co., Inc.

286 Turbine Speed Control — Thirty-pp wire-bound Bulletin H-21 is titled "Fundamentals of Turbine Speed Control." It is an elaborately illustrated, educational booklet intended to clarify operation of common types of automatic speed control for steam turbines. An introductory section covers general fundamentals of automatic control systems, and includes a key to control terminology. Simplified diagrams show operating principles of actual control systems. Elliott Co.

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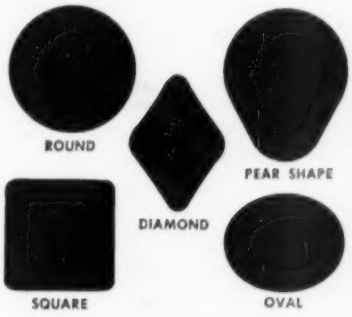

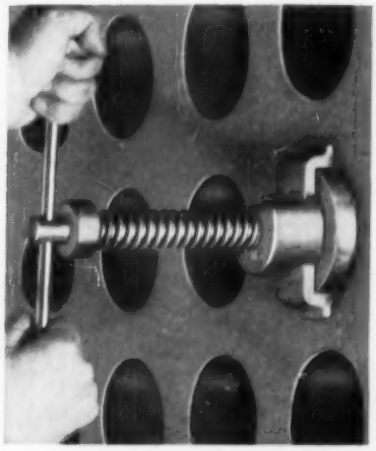

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287 Centrifugal Dust Collector — Twelve-pp Bulletin 100 introduces the Cyclo-trell multiple tube dust collector which operates on centrifugal collection principles and incorporates new features to boost collection efficiency and gas handling capacity. An illustrated explanation of operation and construction of this collector is accompanied by collection efficiency and capacity nomographs. Tables give design data for six sizes, from three to 20 tubes. Research-Cottrell, Inc.

288 Sectional Condenser — Bulletin 131 shows benefits of sectional-design refrigeration condensers for 100 to 240 tons refrigeration capacity and explains their functions with diagrams and installation photos. A cutaway shows component parts. Niagara Blower Co.

289 Heavy Duty Fans — Eight-pp Bulletin 4824 describes new Airfoil centrifugal fans for heavy duty industrial applications. Discusses performance features and construction details of the fans. Text is supplemented with photos and drawings of wheel, housing, bearing, shaft. Several possible volume control methods that can be used with these fans are described and evaluated. Brake horsepower curves for four volume control methods are included. American Blower Corp.

290 Technical Refrigeration — Twelve-pp Bulletin 754 covers a complete line of environmental testing and processing equipment. Provides illustrations and specifications on recently redesigned altitude, humidity, low temperature and prefabricated test chambers as well as specialized testing equipment. Includes helpful engineering data. Bowser, Inc.

291 Corrosion Control — Treatment of industrial equipment to control corrosion cannot be a hit-and-miss proposition, cautions this 6-pp folder. Examples are given of optimum control measures that may avoid costly, unsound treatment procedures, including minor physical or operating changes. Hall Laboratories, Inc.

292 Precipitation Products — Twelve-pp Bulletin G406 contains helpful information on company's various precipitation products, including electrical precipitators, multiclone mechanical dust collectors, combination multiclone-precipitator units, Dualaire filter-type dust collectors and Holo-Flite processors. Also illustrates a number of typical installations. Western Precipitation Corp.

293 Feedwater Treatment — Process Bulletin B1, "Treatment of Boiler Feedwater by Direct, or Internal Method," discusses advantages of direct treatment, as a complete treating program or as a supplement to external systems. Explains why direct treatment is convenient, economical. National Aluminate Corp.

294 Underground Pipe Insulation — This illustrated bulletin discusses the problems of underground pipe insulation and explains how company's insulation for hot underground pipes overcomes them. On-the-job photos illustrate ease of application; brief technical data are also included. American Gilsonite Co.

295 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

296 Sheet and Plate Fabrication — Illustrated in 40-pp Bulletin F-3 are products of this manufacturer, and equipment used to produce special sheet steel and alloy parts. Shows control panels, switch gear housings, cubicles and other electrical enclosures, boiler air ducts, smoke breechings, tanks. The Kirk & Blum Mfg. Co.

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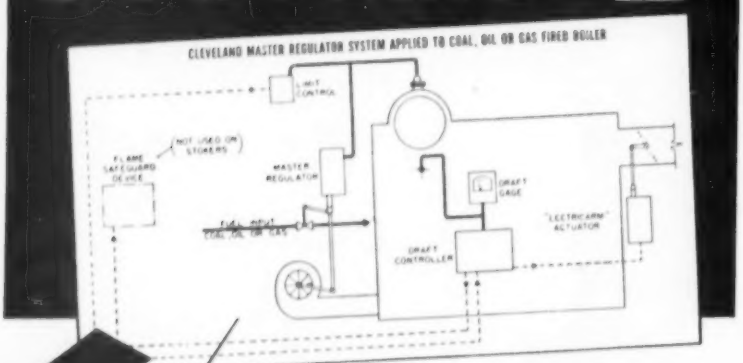
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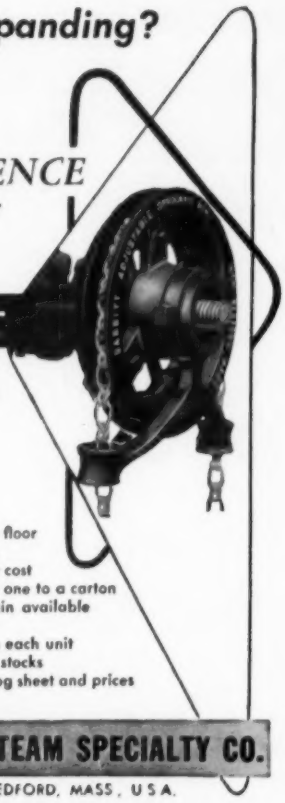

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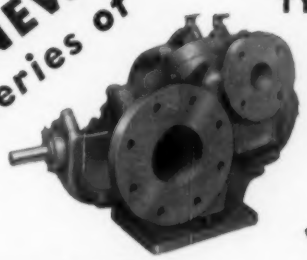

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Agency—Harding & Co., Inc.
ALLIS-CHALMERS MFG. CO. 44–45, 53, 62
Agency—Compton Advertising Inc.
ALLIS-CHALMERS MFG. CO. (TRACTOR DIV.) 64
Agency—Bert S. Gittins Advertising
AMERICAN BLOWER CORP. 14–15
Agency—Brooke, Smith, French & Dorrance, Inc.
AMERICAN BRASS CO. ..... *
Agency—Kenyon & Eckhardt, Inc.
AMERICAN CHAIN & CABLE CO., INC. 128
Agency—Reincke, Meyer & Finn, Inc.
AMERICAN CHIMNEY CORP. 148
AMERICAN GILSONITE CO. ..... *
Agency—Fred Wittner Advertising
AMERICAN PULVERIZER CO. 30
Agency—Batz-Hodgson-Neuwoehner
ANDERSON CO., V. D. 122
Agency—Will Inc.
ARMSTRONG MACHINE WORKS 7
Agency—Russell T. Gray, Inc.
ATOMICS INTERNATIONAL 125
Agency—Batten, Barton, Durstine & Osborn, Inc.
AURORA PUMP DIVISION, THE NEW YORK AIR BRAKE CO. 153
Agency—Fred A. Henrichsen Advertising Agency

BABBITT STEAM SPECIALTY CO. 153
Agency—George T. Metcalf Co.
BABCOCK & WILCOX CO., THE (BOILER DIV.) 60–61
Agency—O. S. Tyson and Co., Inc.
BABCOCK & WILCOX CO. (REFRACTORIES DIV.) 31
Agency—Michel-Cather, Inc.
BAILEY METER COMPANY 20
Agency—Fuller & Smith & Ross, Inc.
BALDWIN-HILL CO. ..... *
Agency—Eldridge, Inc.
BALTIMORE & OHIO RR. 138
Agency—Richard A. Foley, Inc.
BARCO MANUFACTURING CO. 116
Agency—Armstrong Advertising Agency
BECKMAN, ARNOLD O., INC. ..... *
Agency—Dozier Eastman & Co.
BELMONT PACKING & RUBBER CO., THE ..... *
Agency—The Michener Co.
BETZ LABORATORIES, INC. 107
Agency—The Michener Co.
BIDDLE CO., JAMES G. 120
Agency—The Roland G. E. Ullman Org.
BIRD-ARCHER CO., THE 147
Agency—The Roland G. E. Ullman Org.
BITUMINOUS COAL INSTITUTE 119
Agency—VanSant Dugdale & Co., Inc.
BOILER ENGINEERING & SUPPLY CO. ..... *
Agency—William Jenkins Advertising
BOWSER, INC. 142
Agency—Willis S. Martin Co.
BRIDGEPORT BRASS CO. ..... *
Agency—Hazard Advertising Co., Inc.
WM. BROS. BOILER & MFG. CO. ..... *
Agency—The Allried Calte Co.
BRUNER CORPORATION 39
Agency—The Saxton Agency
BUSSMANN MFG. CO. 16–17

C & D BATTERIES ..... *
Agency—John T. Hall & Co.
CAMBRIDGE INSTRUMENT CO., INC. 155
Agency—E. M. Freystadt Associates, Inc.
CHAPMAN VALVE MFG. CO., THE ..... Inside Back Cover
Agency—Sutherland-Abbott
CHESAPEAKE & OHIO RAILROAD 36
Agency—Robert Conahay, Inc.
CLEVELAND FUEL EQUIPMENT CO. 152
Agency—Ad Enterprise Advertising Agency
COCHRANE CORPORATION ..... *
Agency—Hering & Co., Inc.
COMBUSTION ENGINEERING, INC. 40–41
Agency—G. M. Basford Company
CONDENSER SERVICE AND ENGINEERING ..... *
Agency—Diener & Dorskind, Inc.
COOK, C. LEE, CO. 47
Agency—Doe-Anderson Advertising Agency
COPES-VULCAN DIV., BLAW-KNOX CO. ..... *
Agency—Ketchum, MacLeod & Grove Inc.
CRANE CO. 49
Agency—The Buchen Company
CRANE PACKING CO. ..... *
Agency—Symonds, MacKenzie & Co., Inc.

DAVIS ENGINEERING CORPORATION ..... *
Agency—Howard A. Harkavy, Inc.
DEARBORN CHEMICAL CO. 127
Agency—The Buchen Co.
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DE LAVAL STEAM TURBINE CO. 5
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DETROIT STOKER COMPANY ..... *
Agency—Witte & Burden
DIAMOND POWER SPECIALTY CORP. 72–73
Agency—Witte & Burden
DODGE MANUFACTURING CO. 136, 137
Agency—Lamport, Fox, Prell & Dolk, Inc.

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FAIRMOUNT CHEMICAL CO., INC. 150
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Agency—O. S. Tyson & Co., Inc.

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Agency—The Aitken-Kynett Co.
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Agency—Ketchum, MacLeod & Grove, Inc.
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Agency—Ketchum, MacLeod & Grove, Inc.
HENSZEY COMPANY 150
Agency—Kark Advertising Agency
HILLIARD CORPORATION, THE ..... *
Agency—Mellor Advertising Agency, Inc.
HILLS McCANNA CO. 118
Agency—Waldie & Briggs, Inc.

ILLINOIS WATER TREATMENT CO. 143
Agency—Cummings, Brand & McPherson
INFILCO INC. ..... *
Agency—Willard C. Gregory & Co.
INTERNATIONAL NICKEL COMPANY, INC., THE 129
Agency—Marschalk & Pratt Co. Division of McCann-Erickson, Inc.

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JOHNS-MANVILLE 66
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Agency—Hoehnle Corp.

E. KEELER CO. ..... *
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KIRK & BLUM MFG. CO. 126
Agency—Baer, Kemble & Spicer
KOPPERS CO., INC. 38
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Agency—The Roland G. E. Ullman Org.

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Agency—Reid, Decker & Stocki, Inc.

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Agency—Fuller & Smith & Ross, Inc.
MARLEY CO., THE 28
Agency—Valentine Radford Advertising
MARYLAND SHIPBUILDING & DRYDOCK CO. 123
Agency—Speed & Company, Inc.
MEAD-MORRISON DIVISION, McKIERNAN-TERRY CORP. 29
Agency—Michel-Cather, Inc.
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Agency—Thomas R. Sundheim
MILTON ROY CO. 57
Agency—The Aitkin-Kynett Co.

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Agency—Tri State Advertising Co., Inc.
NATIONAL AIROIL BURNER COMPANY, INC. ..... *
Agency—R. E. Lovekin Corp.
NATIONAL ALUMINATE CORPORATION 24
Agency—Armstrong Advertising Agency
NEW ENGLAND CARBIDE TOOL CO. 148
Agency—Calloway Association
NIAGARA BLOWER COMPANY ..... *
Agency—The Moss Chase Company
NORTH AMERICAN MOGUL PRODUCTS CO., THE 117
Agency—Ritchie & Sattler, Inc.

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Agency—Fuller & Smith & Ross, Inc.
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Agency—W. S. Kirkland Advertising
OLIN MATHIESON CHEMICAL CORP. 132
Agency—Doyle, Kitchen & McCormick, Inc.

PERMUTIT CO., THE 10–11
Agency—Cunningham & Walsh, Inc.
PHILADELPHIA PUMP & MACHINERY CO. ..... *
Agency—The Michener Co.
PITTSBURGH PIPING & EQUIPMENT CO. 1
Agency—W. S. Hill Co.
POWELL VALVES 114
Agency—The Ralph H. Jones Co.
PRAT-DANIEL CORP. ..... *
Agency—Hering & Co.
PRATT, HENRY ..... *
Agency—Hollander & Waghorn Advertising Agency
PREFERRED UTILITIES MFG. CORP. 134
Agency—Spooner & Kriegel
PROPORTIONEERS, INC. 144
Agency—Horton, Church & Goff, Inc.

RAYBESTOS-MANHATTAN, INC. 130
Agency—Gray & Rogers
REFRACTORY & INSULATION CORP. 58
Agency—Spooner & Kriegel
RELIANCE GAUGE COLUMN COMPANY 56
Agency—Carr Liggett Advertising Inc.
REPUBLIC FLOW METERS CO. 68–69
Agency—Stoetzel & Associates, Inc.
RESEARCH-COTTRELL, INC. ..... *
Agency—Michel-Cather Inc.
REVERE COPPER & BRASS, INC. 115
Agency—St. Georges & Keyes, Inc.
RHOPAC, INC. 155
Agency—Merchandising Advertisers, Inc.
RIC-WIL, INC. 36
Agency—Ritchie & Sattler, Inc.
RILEY STOKER CORPORATION 22–23
Agency—Seth R. Martin
ROCKWELL CO., W. S. ..... *
Agency—Spooner & Kriegel
ROSS HEAT EXCHANGER DIVISION ..... *
Agency—Harold Warner Co.
ROTHLAN CORP. ..... *
ROTO DIV. OF ELLIOTT CO. 151
Agency—Jos. Vogel & Co.
R-P & C VALVE DIVISION, AMERICAN CHAIN & CABLE CO., INC. ..... *
Agency—Reincke, Meyer & Finn, Inc.,

SARCO COMPANY, INC. 51
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.
SARGENT & LUNDY 113
Agency—Armstrong Advertising Agency
M. SETLOW & SON, INC. 148
Agency—J. W. Shepard Co.
SINCLAIR REFINING CO. 27
Agency—Morey, Humm, & Warwick, Inc.
SOCONY MOBIL OIL CO., INC. 42–43
Agency—Compton Advertising, Inc.
SPENCE ENGINEERING CO. ..... *
Agency—Michel-Cather, Inc.
STANDARD OIL CO. (INDIANA) 63
Agency—D'Arcy Advertising Co.
STEARNS MAGNETIC PRODUCTS 131
Agency—Bert S. Gittins Advertising, Inc.
STEPHENS-ADAMSON MFG. CO. 145
Agency—Connor Associates, Inc.
STICKLE STEAM SPECIALTIES CO. ..... *
Agency—W. H. Rohr, Jr.
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Agency—Batten, Barton, Durstine & Osborn, Inc.

VOGT MACHINE CO., HENRY 21
Agency—Forson, Huff & Northlich

WALWORTH COMPANY, THE ..... *
Agency—G. M. Basford Company
WESTERN CHEMICAL COMPANY 149
Agency—Carter Advertising Agency, Inc.
WESTERN PRECIPITATION CORP. 156
Agency—Dozier Eastman & Co.
WICKES BOILER CO. 37
Agency—Price, Tanner & Willox, Inc.
WILLIAMS GAUGE CO. ..... *
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YARNALL-WARING COMPANY 8–9, 74
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CAMBRIDGE pH INDICATORS and RECORDERS

Labor saving—profit producing!

In addition to portable pH meters, Cambridge makes line-operated Direct Reading pH Indicators and Recorders for permanent installation. They are accurate, stable and assure continuous and trouble-free performance. Either the Recorder, Indicator or both, may be located at any reasonable distance from one or several sampling points. The Glass Electrodes are placed in vapor-tight housings of clog-free sampling chambers.

Send for Bulletin No. 910 T

CAMBRIDGE pH EQUIPMENT

CAMBRIDGE INSTRUMENT CO., INC.

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PIONEER MANUFACTURERS OF PRECISION INSTRUMENTS

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Always Available – Quickly!

RHOPAC Top Quality

Gaskets and Tapes. Making gaskets and tapes from top quality Asbestos Wire Inserted Cloth is a Rhopac specialty. Specify Rhopac boiler gaskets, folded tapes (plain or tadpole), and retort door packing. Prompt service — low prices.

Sheet Gasket Materials. All standard gasket materials in various thicknesses kept in stock at all times — available in sheet or roll form. Your order will receive immediate attention.

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Mechanical Packings. We stock a wide selection of high temperature, high pressure and all standard types of packing. Special requirements are also developed and produced on short notice.

See Rhopac on All Gasket and Packing Problems

Exceptional Service — Top Quality

Rhopac, Inc.

3401 Cleveland Street, Skokie, Illinois

Manufacturers of mechanical packings, industrial and boiler gaskets, steel rule dies, flexible packing hooks.

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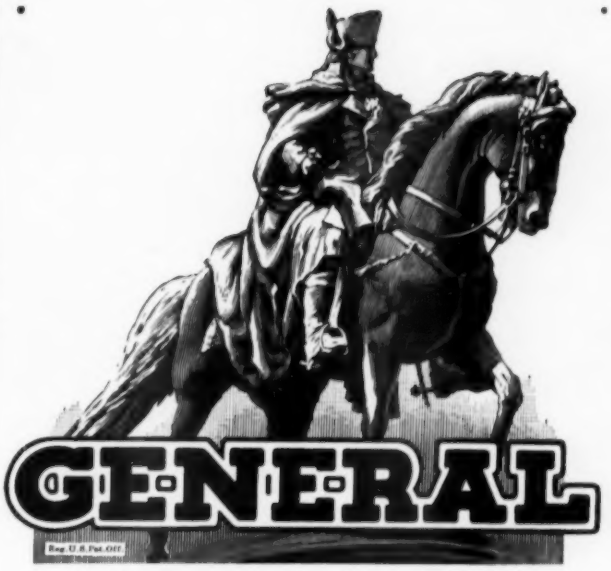

Westmoreland Coal Company

HAMPTON COAL · CRITERION COAL

Stonega Coke and Coal Company

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General Coal Company

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Cable Address: GENCO

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For Fly Ash Collection...

Western Precipitation
presents
its latest development
in a quarter-century of
continuous advancement
in Mechanical Collectors

...The "9VGR" MULTICLONE!

Over 25 years ago

Western Precipitation Corporation pioneered the high-efficiency multiple-tube principle that has proven so superior it is now the pattern for the industry.

The Multiclone continues to be *years ahead* of all other centrifugal collectors because it incorporates the invaluable "know-how" gained through these many years of leadership in the field —leadership that is further emphasized by introduction of the 9VGR Multiclone, another important milestone in Multiclone's quarter-century of outstanding performance.

COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
DUALAIRE Reverse-Jet Filters
HOLO-FLITE Processors

NEW 9VGR FEATURES...

1. *No need for continuous external support.*
2. *Easier and less costly to insulate.*
3. *Minimum dust stratification.*
4. *Improved dust distribution to all tubes.*
5. *Simpler installation, lower erection costs.*
6. *Freedom from leakage at all critical points so that full collection efficiency is obtained.*

Plus **The proven superiority of CAST IRON TUBES and VANES!**

Through the years, others have tried special alloy steels and so-called "miracle" metals, but nothing has proven as satisfactory *in actual field service* as cast iron. In the past quarter-century more than 270,000 Multiclone tubes have been placed in service with less than 1.85% replacement—*a performance record unequalled in the industry!*

There are many other advantages built into the 9VGR. There is a Multiclone representative near you who will be glad to supply complete details. Or write direct, asking for your free copy of Bulletin #M209 which contains full details.

Western Precipitation Corporation

Designers and Manufacturers of Equipment for Collection of Suspended Material from Gases ... and Equipment for the Process Industries

Main Offices: **1029 WEST NINTH STREET, LOS ANGELES 54, CALIFORNIA**

Chrysler Building, New York 17 • 1 North La Salle Street Building, Chicago 2 • Oliver Building, Pittsburgh 22 • 3252 Peachtree Road N. E., Atlanta 5 • Hobart Building, San Francisco 4

Precipitation Company of Canada Ltd., Dominion Square Building, Montreal

Representatives in all principal cities

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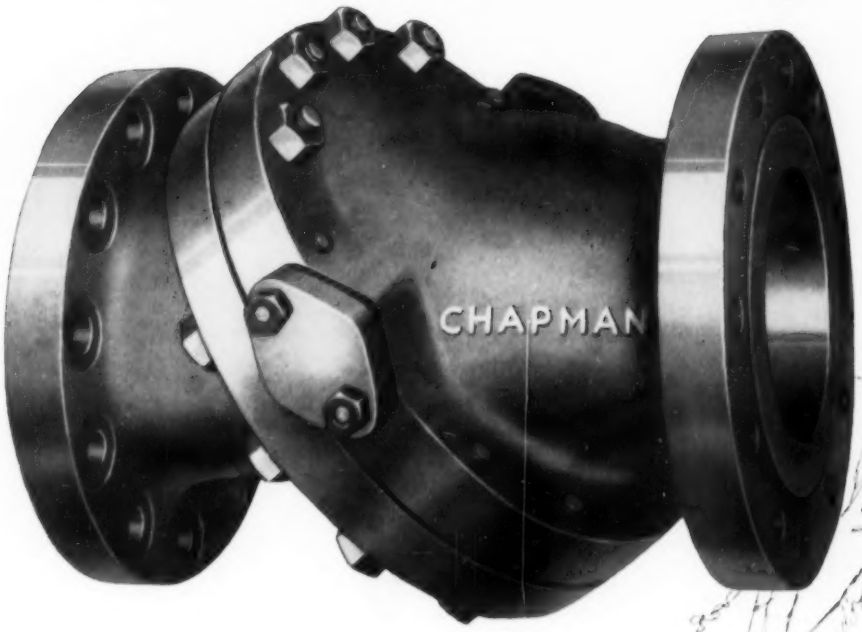
First with Floating Power



ALWAYS QUIET... ALWAYS QUICK

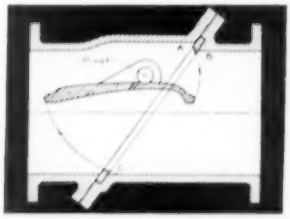
CHAPMAN

Tilting Disc Check Valve

You hear a lot about floating power these days. But Chapman Tilting Disc Check Valve has had it for quite some time. In fact Chapman was the first to have it . . . the first to have it in a valve . . . a feature that means much more to you in performance, much less to you in costs.

With Chapman's Tilting Disc Check Valve the "Airfoil" disc floats on the flow. When the flow is on, the disc balances perfectly . . . and quietly. There's never a flutter. No vibration. No trouble with head loss or flow resistance. And after the flow subsides the disc automatically drops to a closed position. The closing is fast. The closure is tight. No slamming. No banging. No damage to valve or system. No scraping or wearing of disc and seat. It all adds up to top performance and lowest maintenance and replacement costs even under severe operating conditions.

For handling fluids or gases under a wide range of pressures, always specify Chapman Tilting Disc Check Valves. They're available in iron or steel. Explained in full in our Catalog 30-A. Yours for the asking. Write.



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

The CHAPMAN Valve
Manufacturing Co.
INDIAN ORCHARD, MASS.

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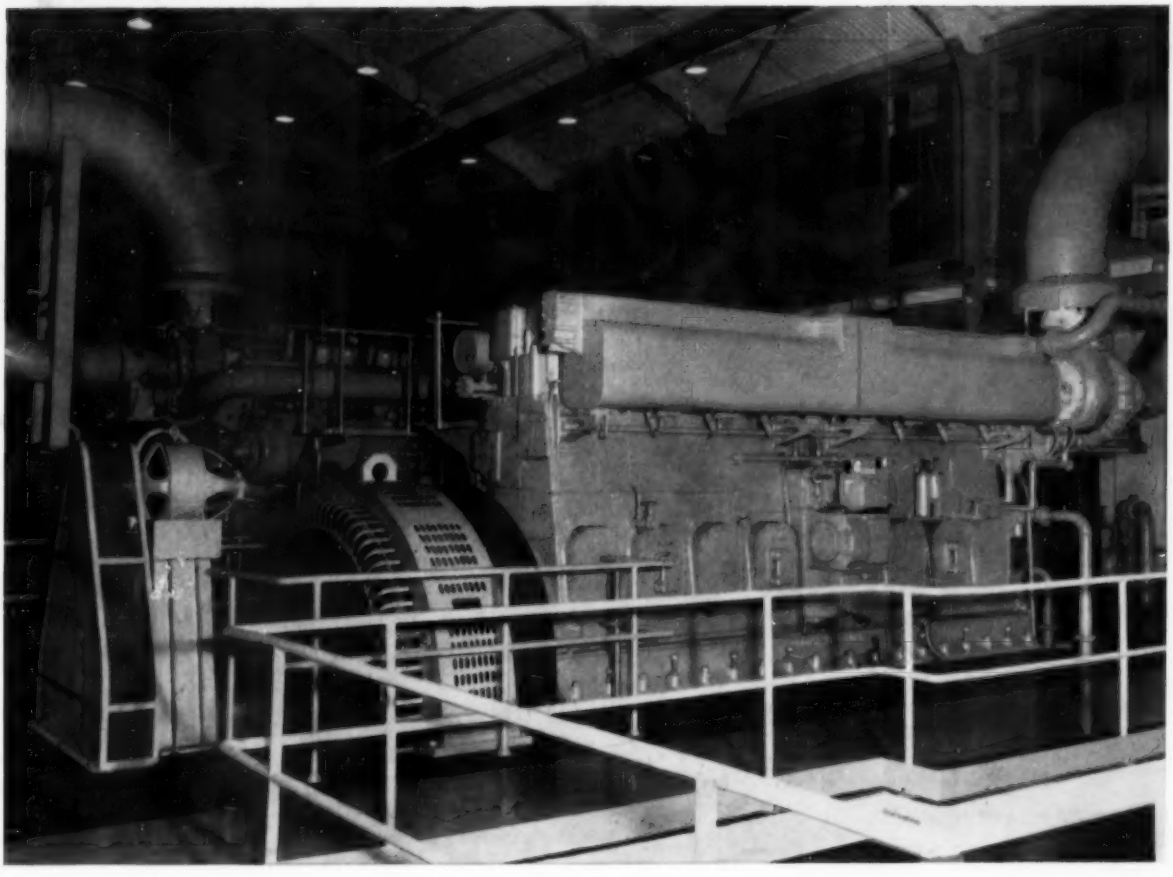

MORE POWER

FROM TEXACO-LUBRICATED ENGINES

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There is a complete line of *Texaco Ursa Oils*, designed and processed especially to make diesel, gas, and dual-fuel engines deliver *more power* with *less fuel* and *longer periods* between overhauls.

For over 20 years, more stationary diesel horsepower in the U. S. has been lubricated with Texaco than with any other brand.

Your Texaco Lubrication Engineer will give you full information. Just call the nearest of more than 2,000 Texaco Distributing Plants in the 48 States or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO URSA OILS

FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

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